ANALYSIS OF MECHANIZED MINING TECHNOLOGIES FOR THE ROMANIAN ROCK SALT DEPOSITS

Ilie Onica, *Prof.Ph.D., University of Petrosani*
Eugen Cozma, *Prof.Ph.D., University of Petrosani*

ABSTRACT: *In the present, for the Romanian rock salt deposits mining are used some rock blasting mining methods and technologies. The goal of this paper is to analyse the possibilities of mechanized extraction of the rock salt by using the road headers and to design the appropriate mining methods in these geo-mining conditions.*

Keywords: rock salt deposit, mining method, rooms and pillars, mechanized technology, roadheader

1. ROADHEADER SELECTION FOR THE TECHNICAL AND GEO-MINING CONDITIONS

The roadheader is a self-propelled unit mining machine that ensures the cutting and loading of the rocks inside horizontal or inclined underground workings (galleries or inclined opening and preparatory workings, tunnels, short mining faces, etc.).

The main technical and geo-mining conditions requested of the road header are the following [5], [6], [7]:

-To be able to excavate a transversal section profile of the mining rooms at the designed section;

-To be able to achieve the average annually production capacity of the saline;

- The consumption of cutting picks needs to be as low as possible [1], [8];

- It should be possible to use an electrical power supply, in the conditions of the existent energetic system of the saline;

- It should be a roadheader with successful world experimentation, in the similar mining conditions of the rock salt or other evaporate rocks;

- It should have very good reliability, be very easy to maintain and operate and should ensure the best conditions of underground health and safety;

The main technical and geo-mining selection criteria of roadheaders should be based on the following requirements:

-To cover the transversal section sizes of the working;

-Correlation of the strike and transversal dips of the mining workings with the technical possibilities of the roadheader;

-Penetration of the roadheader tracks in the underground working floor;

-The main performances of the roadheader (instantaneous cutting rate and specific cutting picks consumption [1], [8]).

2. MINING TECHNOLOGY BY USING THE ROADHEADER

2.1. Mining method description

At the Romanian rock salt deposits, in the most saline, are used the mining method with rooms and square pillars, with the plain ceiling [2], [3], [4]. The characteristic parameters of these methods are:

-the roof (crown) pillar of the rock salt deposit has a minimum thickness of 30m;

-the floor pillar has a minimum thickness of 25 m;

-the marginal pillars have a minimum thickness of 8 m;

-the mining pillars, between rooms, are a square shape with sizes of 14x14 m, until 18x18 m, depending on the overburden, and the height of 8m;

-the mining rooms have a plain ceiling, with the width ranging from12 m until 16 m, depending on the overburden of the mining level, and the height of 8 m.

2.2. Establishment of the mining technologies and the face equipments

As a result of the research carried out by the paper authors, for the mining method with rooms and square pillars, the mining face technology recommended involve the Sandvik MR-520 roadheader (Fig.1) and the loading with the roadheader in the Renault Kerax 420/42 trucks [6], [7].

Fig.1. Sandvik MR-520 Roadheader

The rooms with the sizes of 8 x 12 m will be mined in two slices with 4m thickness, and every slice is extracted in two strips with the width of 6 m until 8 m. At beginning, is mined the upper slice, in advance with a room, after that is mined the lower slice.

The main stages of the salt mining process are the followings:

a) the driving of the preparatory gallery on the upper slice of the mining panel of the level;

b) the cutting and the loading with Sandvink MR-520 roadheader in the Renault Kerax 420/42 trucks;

c) the checking and the excavation jowling of the face.

2.3. The cutting with the Sandvik MR 520 roadheader

The Sandvik MR 520 roadheader is a ripping or transversal roadheader (with the rotational axe of the cutting heads parallel with the working face). The cutting arm revolves after the horizontal plane, along the entire face. When the cutting heads penetrated the face, is regulated the cutting depth"X". Before the every horizontal cutting, the cutting head is regulated for the cutting thickness"Y", penetrating the rock salt face on a supplementary depth. The cutting depth and the cutting thickness are calculated in function of the rock salt physical and mechanical characteristics.

The rock salt face penetration is achieved by the road header arm adjustment or the roadheader motion, whereas the cutting arm revolves in horizontal way.

The loading table, in the cutting operation, must be set on the floor for loading the rock salt during the roadheader advancement. After the initial rock salt face penetration, by the arm motion, is cut a floor kirve along the entire cutting width and is regulated the cutting depth "Y" and is revolved horizontally the arm. The cutting is made in shuttle way, on entire rock salt surface.

The rock salt extraction from the rooms, between the square pillars, is achieved in conformity with the stages shown in the Fig. 2 and 3.

The rock salt mining is provided into a two successive slices (first slice and second slice) with height of 4 m, into an established order. Every slice with 4 m of height, from every room (with total height of 8 m and the width of 12 m until 16 m) is mined in two strips with the width of 6 – 8 m. From the technical characteristics of the Sandvik MR 520 roadheader, results that maximum sizes of the transversal profile, possible to be extracted with the roadheader, situated into a single position are: the maximum height of 5.2 m and the maximum width of 8.32 m (the covering values for a strip with height of 4 m and the width of 6-8 m).

In the case of the width of rooms of 12 m, the road header cut the rock salt working face, from a single position, in the arc of a circle with the length of 6.3 m, and the rotation angle, left-right, in the horizontal plane, of the cutting booms is about 31.5^{o} (Fig.2 and Fig.3).

The technological process of a slice mining, from the total of four slices, corresponding with the transversal section of a room, involves the following cutting stages:

Stage 1: From the stationary position of the roadheader, focused on the strip axis with the sizes of 6 m x 4 m (section of 24 m^2), the cutting crown penetrate the rock salt massive at the on of the strip extremity, on the width of 2.38 m (with of the cutting head) and a depth of 0.625 m (half of the crown diameter) and a height of 1.25 m or 1.3 m following the vertical curvature of the face (the rock salt detached volume is about 1.58 m^3);

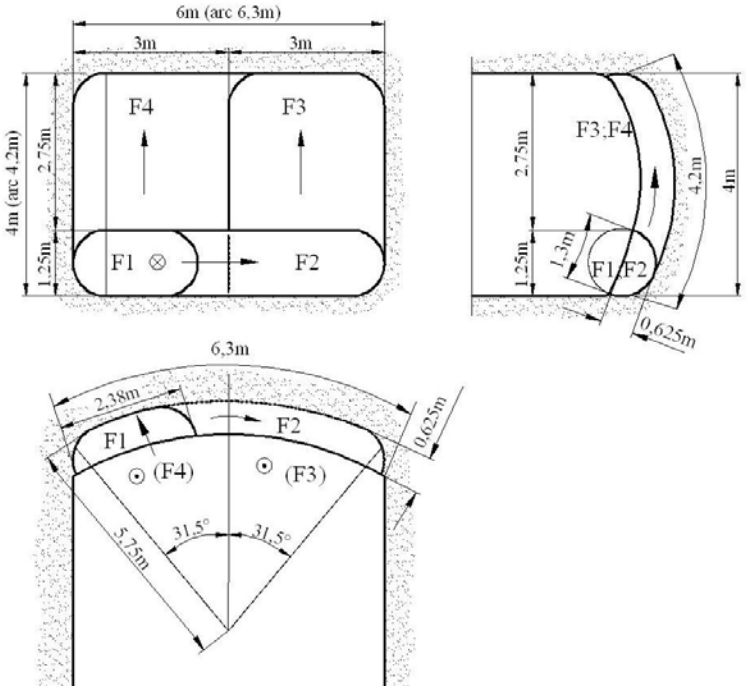

Fig.2. Representation of the roadheader main cutting stages of the first strip

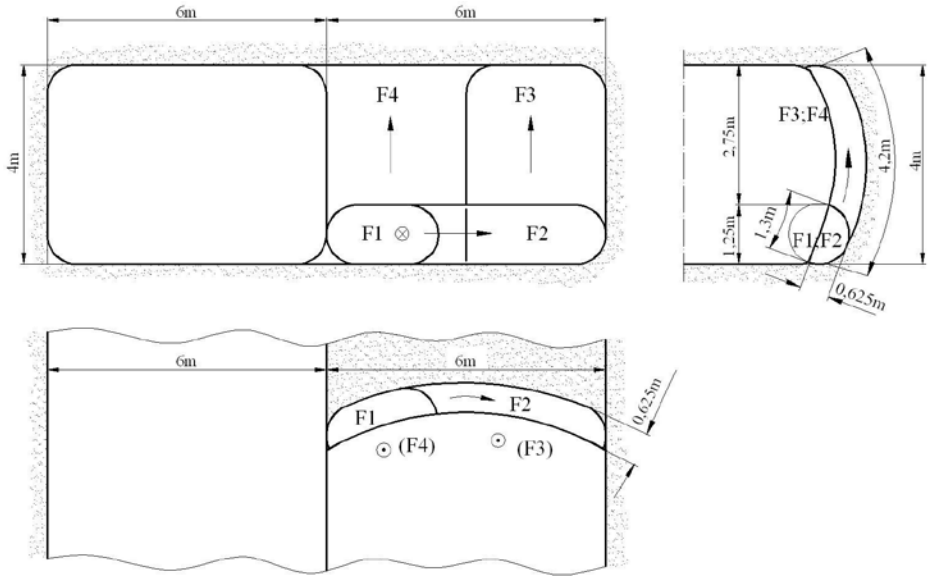

Fig.3. Mining with the roadheader of the second strip, slice I

Stage 2: The cutting of horizontal kirve continues with the displacement of the cutting crown in a horizontal plane, until the right extremity of the face, achieving a floor kirve, following the entire arc of 6.3 m (the excavated rock salt volume is 2.6 m^3);

Stage 3 and 4: After a strip floor extraction of 1.25 m, is continued the rock salt extraction, following the vertical plane, of a width face portion of 3.0 m (or 3.15 m, following the arc length), by the vertical displacement of the crown, with 20-30 cm left-right motions, which leads to ascendant cutting of a rock salt volume about 5.7 m^3 (excavated sizes of the rock salt being: cutting step of 0.625 m, height of 2.9 m and the width of 3.15 m).

The stages 1, 2, 3 and 4 are repeated, also at the second strip from the first slice, after that in the second slice, for to reach the designed sizes of the mining rooms.

After the achievement of the step of 0.625 m, the roadheader is retreated, is put on the center, and the cycle is repeated, until it is extracted the first strip on the 15 m length, after that the roadheader is retreated in the back with 15 m and is cut the second on a length of 30 m. The previous stages shown in the Fig.2 and 3 are repeated along the entire rooms' length at the second strip and after that, in the others strips of the second slice.

3. TECHNOLOGICAL STAGES OF THE ROOMS MINING

The technological stages involved by the process of the rock salt mining using the road header, in the case of rooms and square pillars mining method [6], [7] are shown in the Fig.4-11.

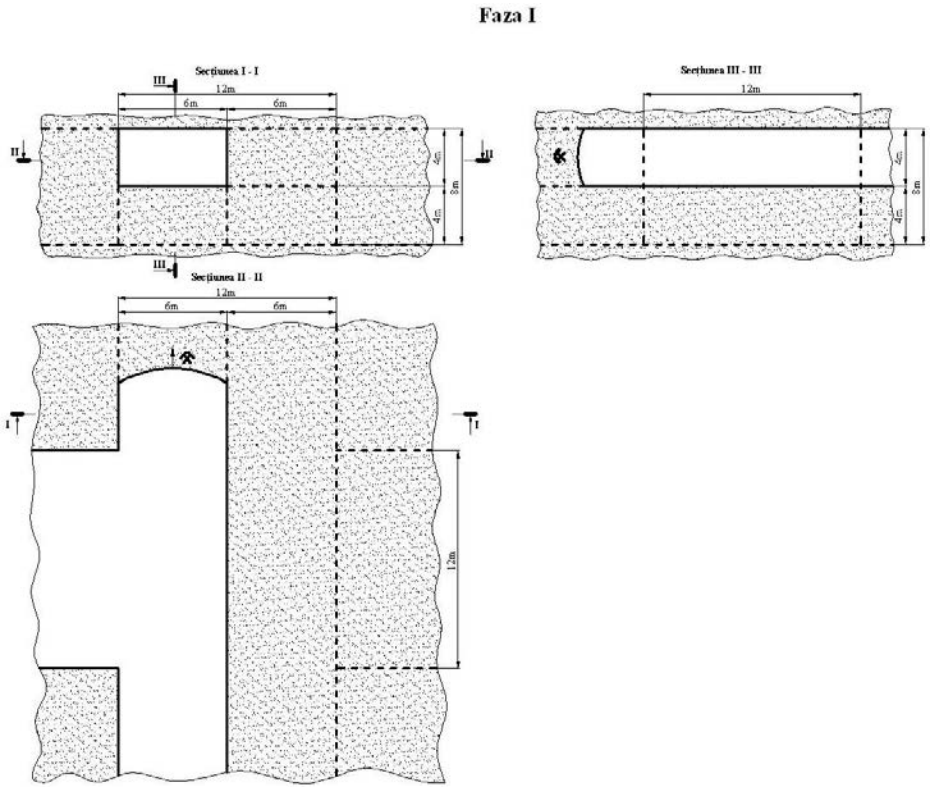

Fig.4. Schema of the strip 1, slice I mining

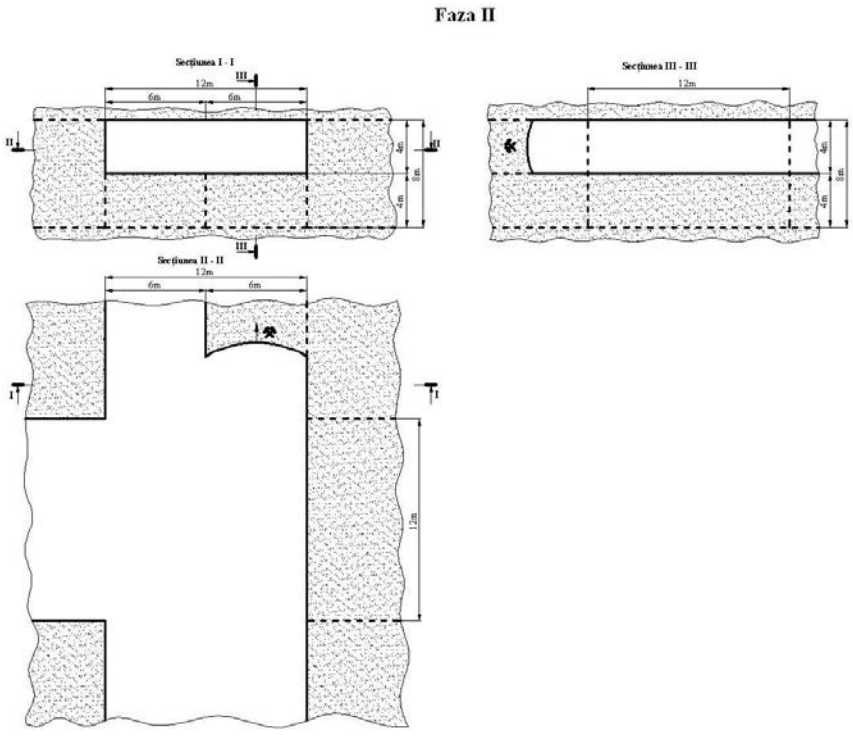

Fig.5. Scheme of the strip 2, slice I mining

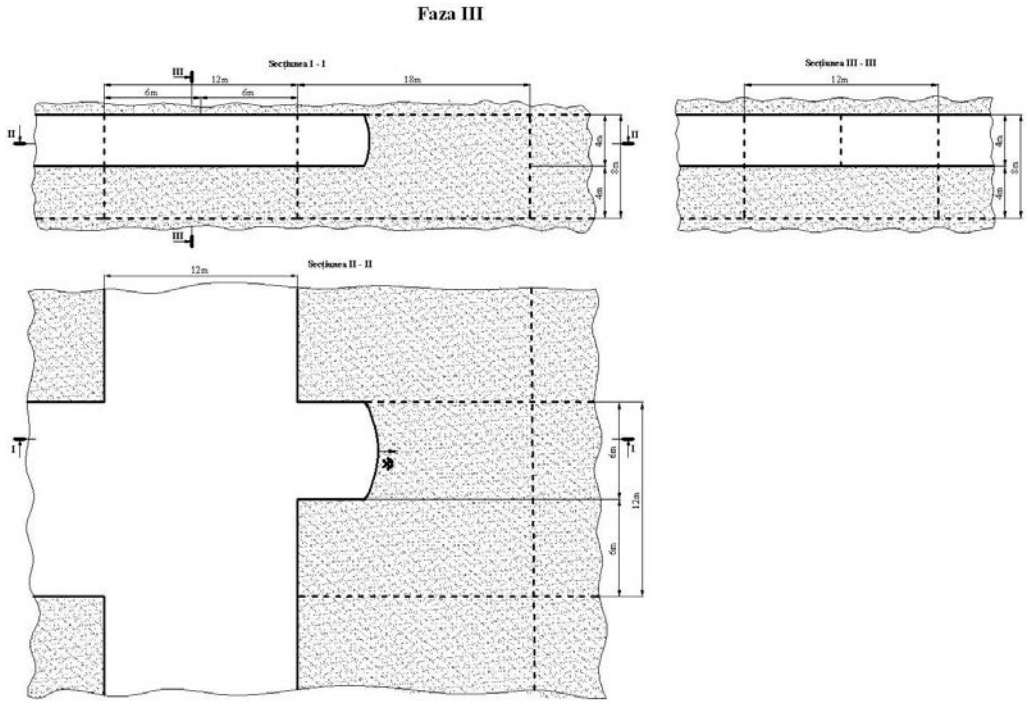

Fig.6. Scheme of the strip 1, slice I mining

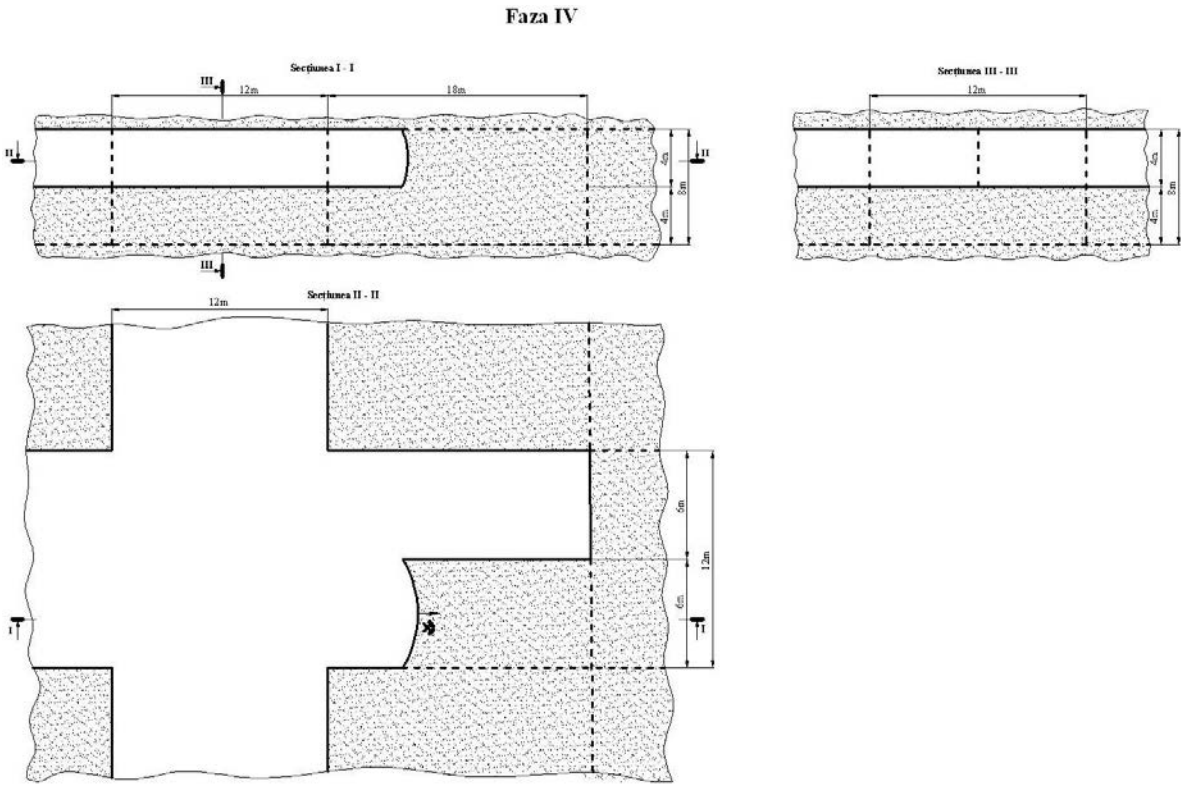

Fig.7. Scheme of the strip 2, slice I mining

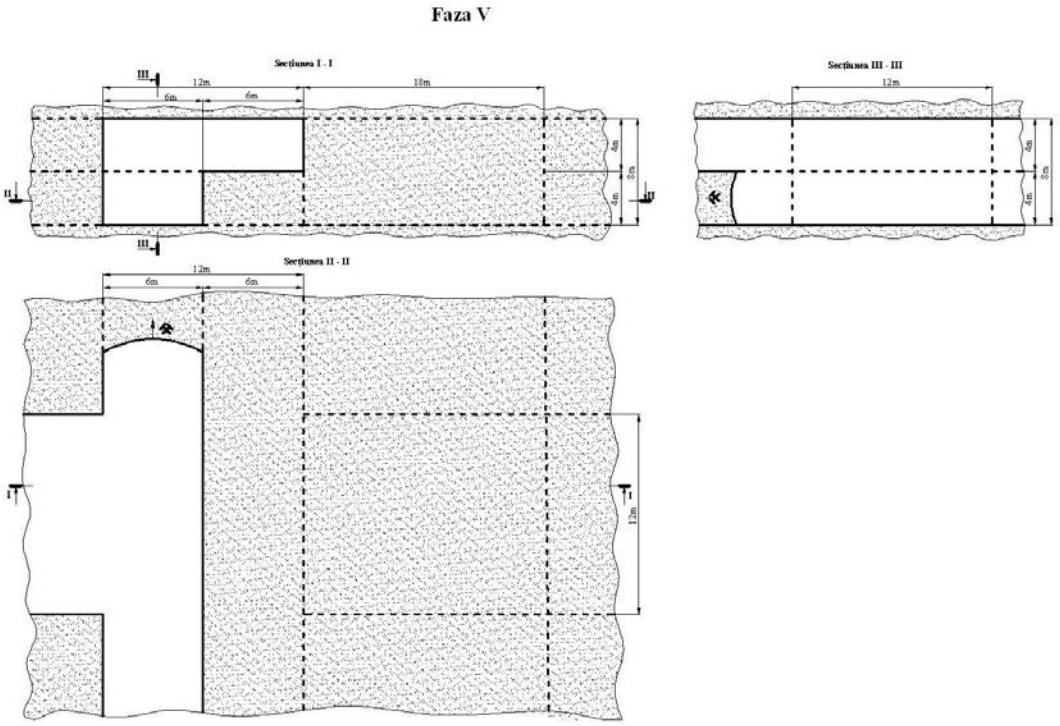

Fig.8. Scheme of the strip 1, slice II mining

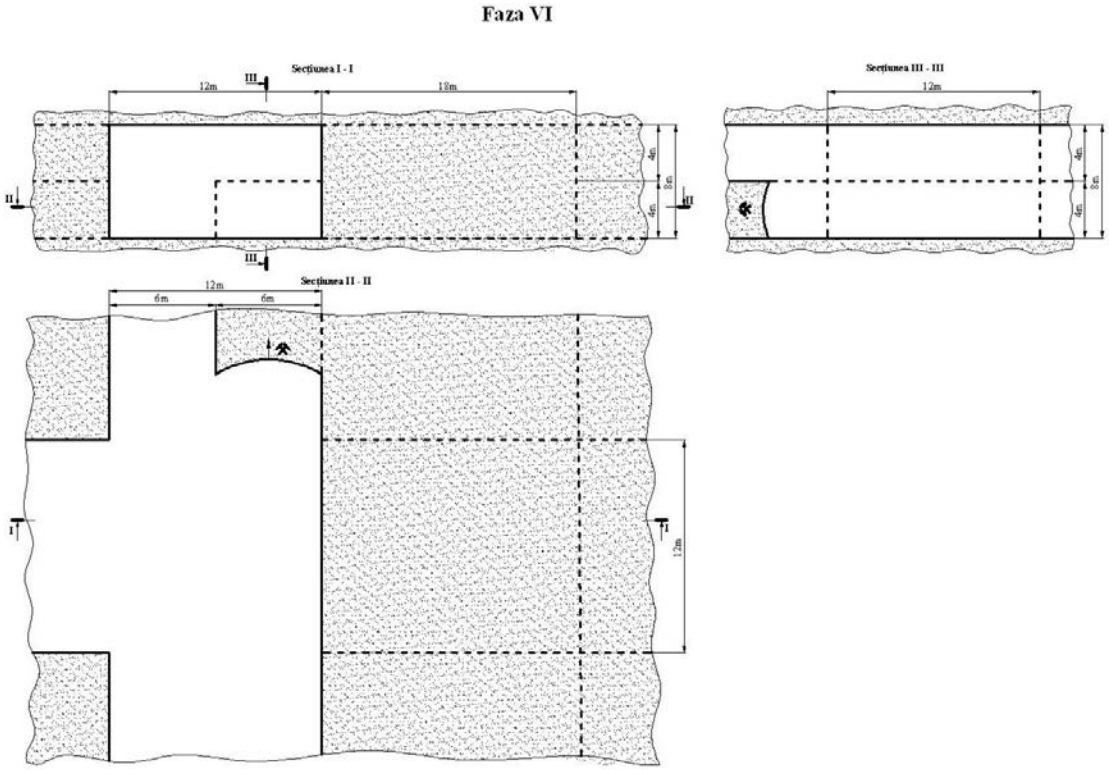

Fig.9. Scheme of the strip 2, slice II mining

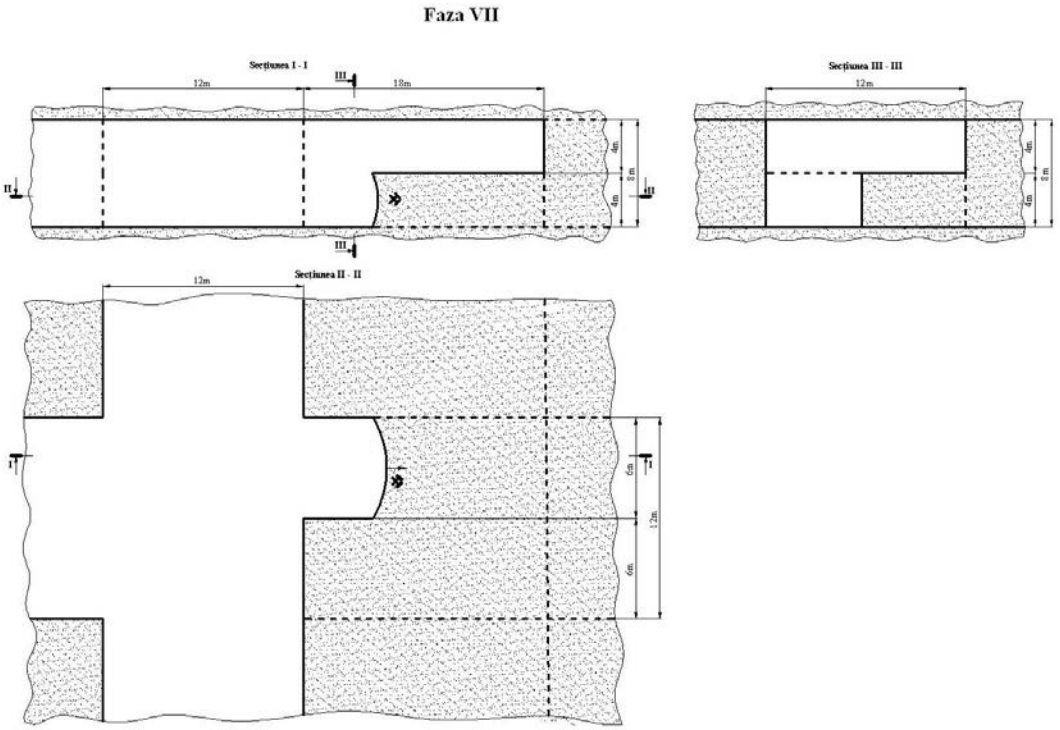

Fig.10. Scheme of the strip 1, slice II mining

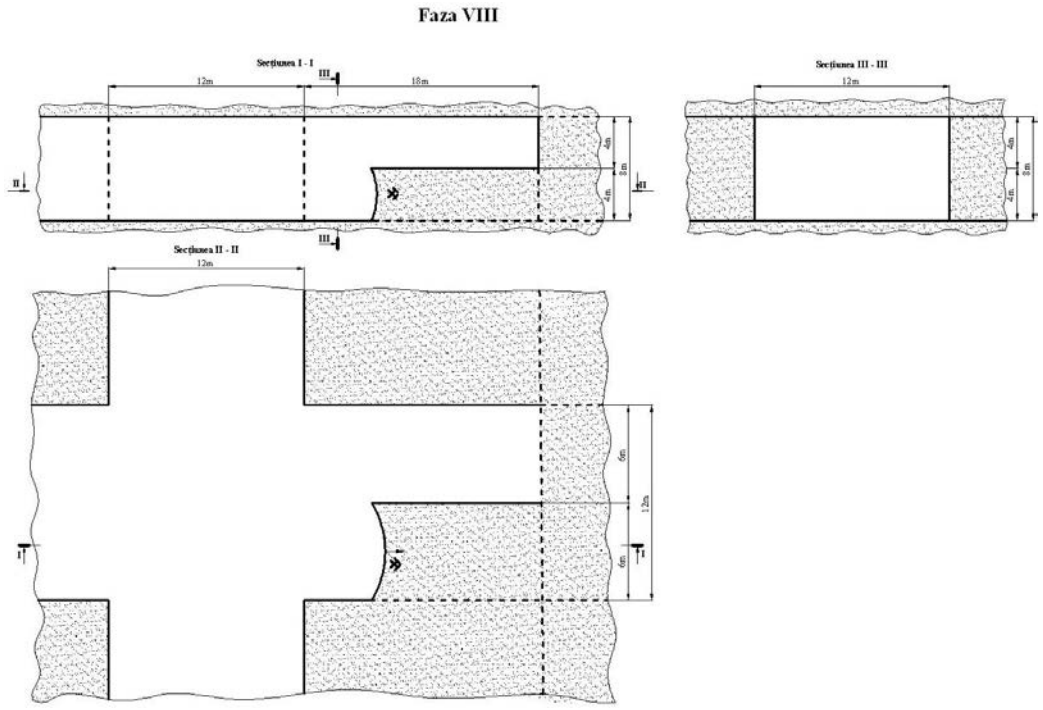

Fig.11. Scheme of the strip 2, slice II mining

4.CONCLUSIONS:

-Sandvik MR-520 roadheader accomplished all the technical, constructive, operating and reliability requirements by report to the technical and geo-mining conditions, imposed by the Romanian saline, for an efficient mining of the rock salt deposits, from of economical and technical point of view.

-By the mechanized mining of the rock salt, the rooms could be with 1-2m larger then in the case of the drilling-blasting cutting system, increasing the recovery rate.

-At the mechanized extraction of the rock salt, are reduced the cost of the rock salt tonne and also the risks.

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