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IMPROVEMENT OF A LONGWALL RECOVERY ROOM ERECTION TECHNOLOGY

Oleg Ivanovich Kazanin
D.Sc., Professor, Dean of the Mining Faculty, Saint-Petersburg Mining University, Russian Federation, 199106, Saint-Petersburg, Vasilievski Ostrov, 21 Linia, 2

Victor Victorovich Klimov
Chief Engineer of Komsomolets Mine Office, JSC SUEK Kuzbass, Russian Federation, 652507, Leninsk-Kuznetsky, Vasilyev St., 1

Vyacheslav Yuryevich Alekseev
Student, Faculty of Mining, Saint-Petersburg Mining University, Russian Federation, 199106, Saint-Petersburg, Vasilievski Ostrov, 21 Linia, 2

Andrey Alexandrovich Sidorenko
Ph.D., Associate Professor, Department of Mining of Mineral Deposits, Saint-Petersburg Mining University, Russian Federation, 199106, Saint-Petersburg, Vasilievski Ostrov, 21 Linia, 2

ABSTRACT

The numerical analysis of the stress-strain state of the rock massif at different location the longwall erection of recovery rooms are executed. Need of accounting of value of periodic roof weighting is shown. As the pacing factors having the impact on the value of periodic roof weighting durability and power of the main roof and speed of advance of the longwall face are specified. The possibility of use of MARCO electro-hydraulic control equipment systems for exact determination of periodic roof weighting is shown. The recovery rooms erection technology providing decrease span of time and costs of moving of the longwall equipment is offered.

Key words: underground mining, coal seams, longwall, recovery room, stability, synthetic mining grid, numerical simulation, periodic roof weighting.

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1. INTRODUCTION

The method of longwall mining is the main method of underground coal mining in Russia. Application of completely mechanized longwalls ensures high rates of performance and safety of underground mining [1-5]. After mining of reserves of longwall panels there is the moving of the equipment of the longwall on the new longwall panel. Now when mining seams longwalls apply two main methods of removal of the equipment. The first method consists in carrying out the recovery room in advance. The second method of removal of the equipment provides forming of the recovery room the longwall. Experience of application of different methods of removal of the equipment shows that the recovery rooms passed in advance are unstable and are very often disintegrated during the approaching of the longwall and influence of bearing pressure [6-11]. Now in mines of the Kuznetsk coal basin the technology of recovery rooms erection the longwall using the synthetic mining grid was widely adopted. However, the analysis of work of longwalls shows that the considerable equipment downtimes connected with exceeding of planned duration of moving of the equipment are observed. Operational downtime of the high-performance equipment of longwalls results in significant economic damage [6, 7, 12-24]. The analysis of cases of moving of the equipment in mines of the Kuznetsk coal basin shows that increase in duration of moving of the equipment is in most cases caused by collapse of the roof of recovery rooms. In this paper questions of ensuring stability of recovery rooms and increase in efficiency of forming of recovery rooms when using the synthetic mining grid are considered.

2. METHODS

When carrying out researches the finite element method for determination of the rational location of the recovery room was used. Researches were conducted for conditions of mining of Tolmachevsky seam in the Polysayevskaya mine. The seam thickness of Tolmachevsky 2.15 m. Immediate roof thickness from 2 to 3 m Main roof thickness from 8 to 16 m. Periodic roof weighting by results of mine observations 22 m was found out. 2D model of the rock massif applied to the numerical analysis is provided in figure 1. Location of the recovery room when carrying out researches changed from 5 up to 17 m (0 m, 5 m, 10 m, 17 m). At location of the recovery room of 0 m - it is at the crack of the break of the main roof.

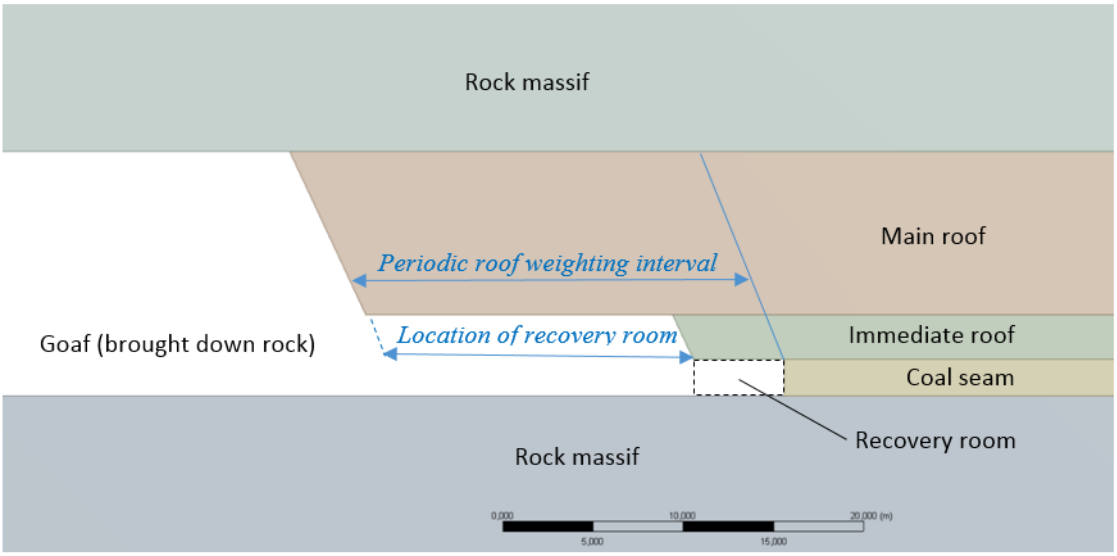

Figure 1 2D model of rock massif for numerical analysis

As roof weightings depends on the strength of rocks and the main roof thickness it is necessary to consider changes of these values when forming the recovery room. When carrying out researches the analysis of change of power of the immediate and main roof longwise of longwall panels in the conditions of the Polysayevskaya mine was made.

3. RESULTS AND DISCUSSION

As a result of executed numerical the analysis stress fields for different options of location of the recovery room concerning the crack of the break of the main roof were received. Figure 2 stress fields around the recovery room are provided. Apparently from figure 2 at location of the recovery room at once the smallest level of tension stresses in the roof of the recovery room is watched the crack of the break of the main roof, and in process of increase in distance from the crack tension stresses in the roof of the recovery room increase up to the room that leads to collapse of the roof of the recovery room. Thus, the most rational is location of the recovery room behind the crack of the main roof at once.

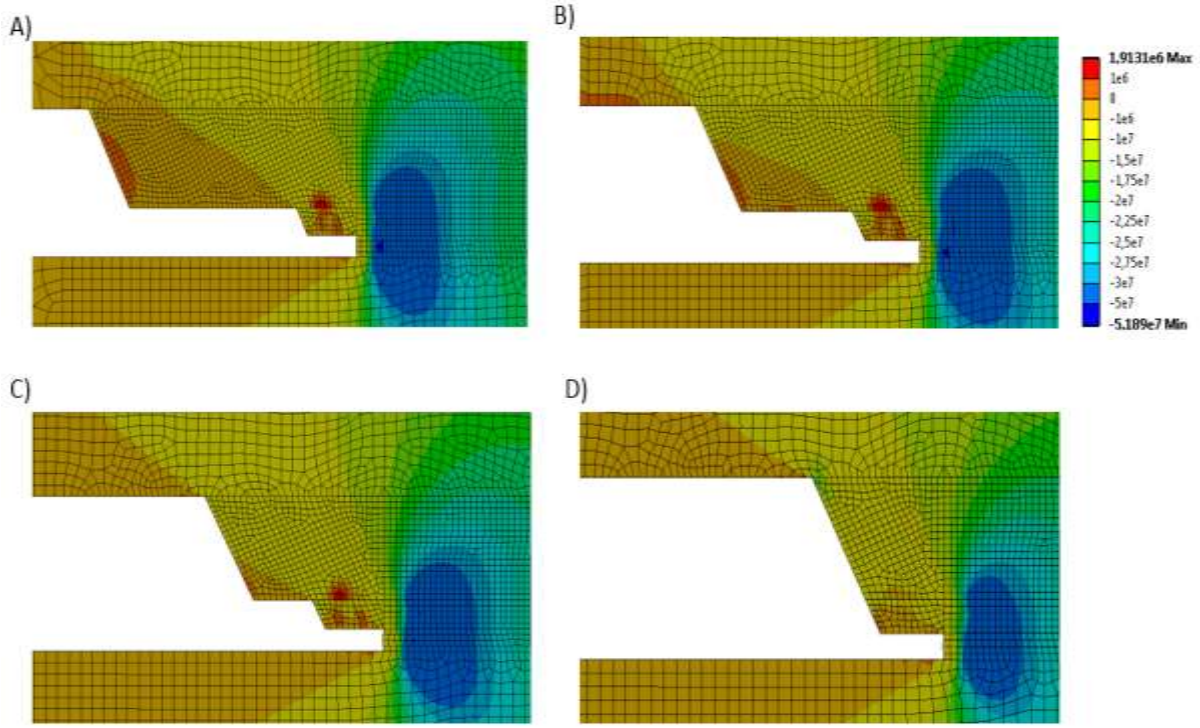

Figure 2 Fields of stress in rock massif

However, location of the recovery room behind the crack in the main roof represents the difficult practical task. Now the location of the recovery room is accepted prior to mining of the longwall panel and does not consider the period of loading of the main roof. It would be possible to calculate the period of roof weighting of the main roof and to locate the room in the place of the calculated collapse, however the analysis of modern method of calculation of the step of the load shows that different techniques yield very different results. Besides, the strength and the main roof thickness which can change very strongly have the impact on the period of roof weighting of the main roof. Also the analysis of references shows that day advance of the longwall also has significant effect on the period of roof weighting. In such conditions the most rational is application of mine measurements of with use systems electro-hydraulic control equipment. Such measurements can be performed with use, for example, of MARCO electro-hydraulic control equipment systems. Systems allow to monitor change of

load of shields with the frequency several measurements in the minute. Thus, before forming of the recovery room the actual step of collapse of the main roof can be defined.

During forming of the recovery room advance of the longwall face very strongly decreases that leads to increase in loading of the main roof. In such conditions we suggest to apply the following technology of forming of the recovery room (figure 3) to ensuring efficiency of forming of the recovery room.

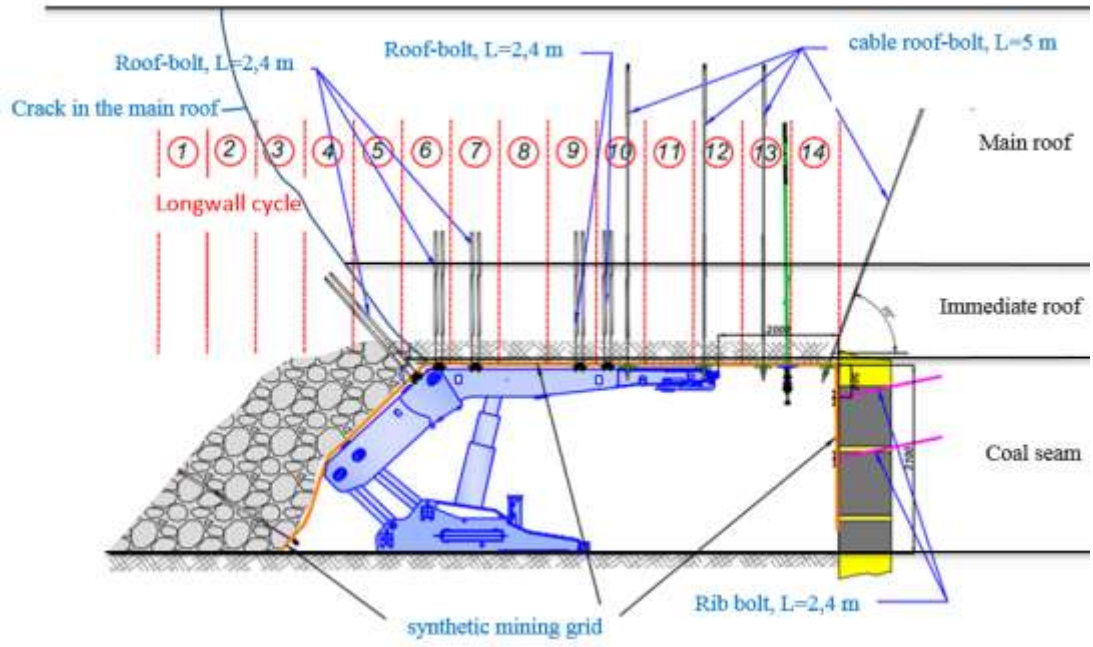

Figure 3 Cross-section of longwall recovery room

Mounting of the synthetic mining grid is performed in the place where collapse of the main roof is expected, however the actual location of the recovery room needs to be provided behind the crack of collapse of the main roof at once that can be provided at increase in width of the recovery room at application of the synthetic grid from long more, than it is necessary. Thus, forming of the room begins after collapse of the main roof and reduction of loads of shields (according to MARCO systems electro-hydraulic control equipment).

4. CONCLUSIONS

As a result of the made numerical analysis distribution of stress around the recovery room at its different provision concerning the crack of the break of the main roof is received. The received results showed need of placement of the recovery room behind the crack of the break of the main roof for stabilization of the roof of the recovery room at once. The analysis of calculation procedures the period of weighting of the main roof showed that results of calculation very strongly differ. Thus, the existing techniques cannot be used for the forecast of the step of loading of the main roof. For reliable determination of the step of roof weighting use of MARCO systems of electro-hydraulic control equipment is recommended. However, the received actual period of weighting will differ as when forming the recovery room advance of the longwall will decrease. Thus, the technology of forming of the room shall provide the possibility of increase in width of the recovery room the fixed grid, for location of the recovery room behind the crack of the break of the main roof that is provided at use of the technology of forming of the recovery room developed by authors.

It should be noted that at the applied technology reduction of length of the longwall panel as a result of forming of the recovery room before the designed location is possible. However, reduction of length of the longwall panel can be from 1 to 15 m that does not affect overall performance of the longwall. The executed assessment of effects from reduction of idle times of the high-performance equipment of longwall as a result of rational location of the recovery room using the developed technology of its forming that costs at removal of one complex can be reduced by 100-900 thousand US dollars.

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