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u saradnji sa
Društvom za geotehniku u Bosni I Hercegovini

Faculty of Mining, Geology and Civil Engineering, University of Tuzla
in co-operation with
Geotechnical Society in Bosnia and Herzegovina

GEO-EXPO 2012

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2nd International Scientific Meeting
GTZ 2012 & GEO-EXPO 2012
Tuzla, June 07-09, 2012

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Roman Yastremskiy[3]

STUDY OF FLOOR HEAVING IN THE MINE WORKING OF A COAL MINE BY MONITORING METHOD

Summary: *The specific properties of the floor heave in condition of Abakumov Mine has been observed. Hard stratum floor has been discovered to be a major feature of floor heave. Results of this study have revealed that floor heave has occurred through four stages. They have been divided by features of floor movement and its deformation. It is established that floor heave occurs with a longitudinal asymmetry incurvation which vertical axis is tilted towards the goaf at an angle 35-50°.*
Key words: *Coal mine, Mine working, Floor heave, Instrumental observations, Monitoring method*

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1. INTRODUCTION

Abakumov Mine is a part of state enterprise “Donetsk Coal Energy Company”. In administrative terms, the mine is situated in Kirovsky Borough, Donetsk. The mining area is located in the western part of Donetsk and Makeyevka geologic industrial districts of the Donets Basin in Ukraine. The mining area of this property is 30 km^2; the strike length is 8.5 km and 3.5 km to the dip.

Abakumov Mine is currently operating in the m_3 coalbed in the western flank of the mining area. The mine uses advancing and retreating longwall mining methods. Longwall panels are mined out by using fully mechanized system.

Nowadays mine is longwalling in the 8th western longwall m_3 coalbed. Working depth is about 860 m and a dip angle is 9°. The longwall panel is 1100 m long and 250 m wide (see Figure 1).

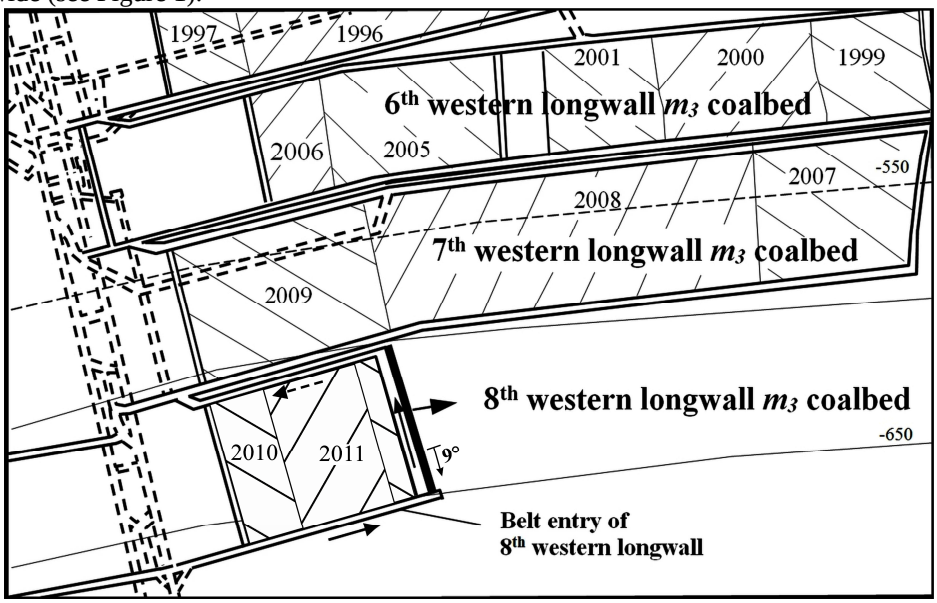

Figure 1. Plan of operation in the longwall area of Abakumov Mine

Drivage is carried out by drilling-and-blasting operations in advance of 5 m. Support system is used in entries of three-link yielding SVP-profile by steel strengthen support for every 0.5 m along the whole entry. Cross-section area is 16.1 m^2. A dirt-filled chock is 1.3 m in width and a hand-built dirt pack is 7.0 m in width were used to protect the entry.

Floor heave occurs in the belt entry of the 8th western longwall m_3 coalbed. When the entry is driven under high stress conditions, the cross-section area accelerates decreases. Basically, it happens on account of the floor heaving in quantity of 60% from convergence.

The amount of floor heaving was approximately 0.4-2.1 m along the whole entry. The miners had to dig out the heaving rock in the floor of the belt entry to keep it in order. In such a way this extra work is giving rise to financial problems and labour costs.

Generally, there are two reasons for floor heave. The first is the occurrence of high stresses within the floor rock [1] and the second is the loss of the floor rock strength [2].

The resulting floor heave usually causes various deformation and displacement such as breaks and haves, producing numerous cracks [3]. In our case research it happens in condition of hard rocks which are adjacent to less hard immediate floor [4,5].

So, studies have been conducted to find out loss of strength of the floor rock for controlling floor heave in order not to be faced with the belt entry problem any more.

2. STRATIGRAPHIC RELATIONSHIPS

Throughout the longwall area, m_3 coalbed thickness averages from 0.9 to 1.0 m. The m_3 coalbed is medium-bright and uniaxial strength is 15-18 MPa.

The immediate roof is grey to dark-grey mudstone with lamination. Mudstone is generally from 7.0 to 10.3 m think and the uniaxial strength is 30-40 MPa.

The immediate floor is dark-grey siltstone with uniaxial strength 40-60 MPa and its thickness is 1.2-1.6 m. Immediately beneath siltstone there is dark-grey to brown limestone, which uniaxial strength is 100-120 MPa and its thickness is 0.3-0.4 m.

Figure 2 is a generalized stratigraphic column of the interburden in the floor which contains hard rocks. Data of the geologic report of Abakumov Mine are used.

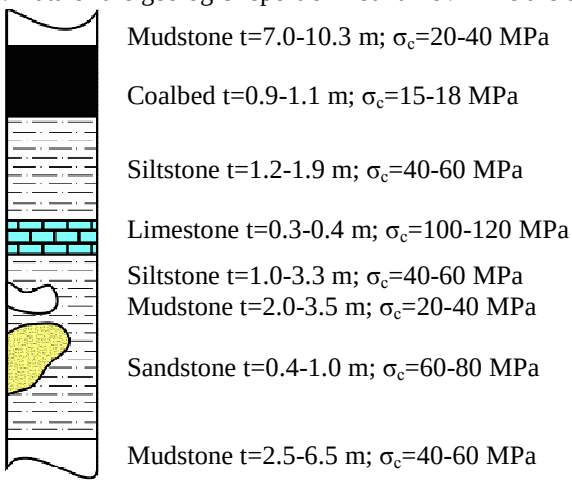

Figure 2. Generalized stratigraphic column

Thus, the stratigraphic column shows that the floor contains limestone and sandstone. Particularly they are adjacent to siltstone.

3. MONITORING METHOD

To establish a better understanding of extensive floor heave, three monitoring station were built along the belt entry of the 8th western longwall m_3 coalbed. The monitoring stations are located by 10 m between them (see Figure 3).

The monitoring station has been consisted of six marks. The mark of wooden rod has length 0.4 m and diameter 0.03 m. Marks were installed in drilled shot holes in the centre roof of entry and in its sides at height of 2.5 m from floor. The rest of marks were

installed in the centre and sides of floor entry, so that their top has been located down at a distance of 0.05 m below the floor surface. On the end of each mark, a fixed steel hook is simply measured by a steel tape.

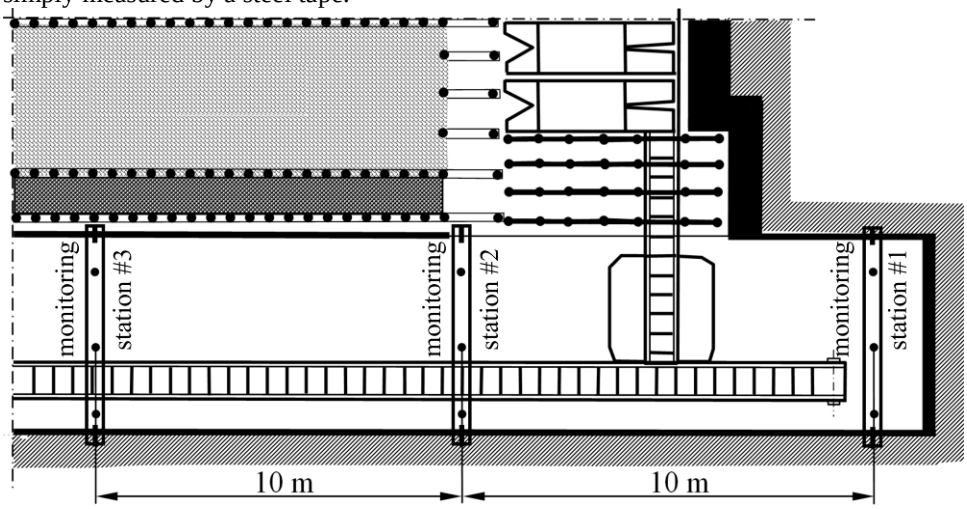

Figure 3. Layout of monitoring stations

Monitoring stations were used to measure the convergence in the height and width of the entry. A distance from the floor and roof marks to the midline (a line between side marks made by a steel tape) is schematically shown in Figure 4.

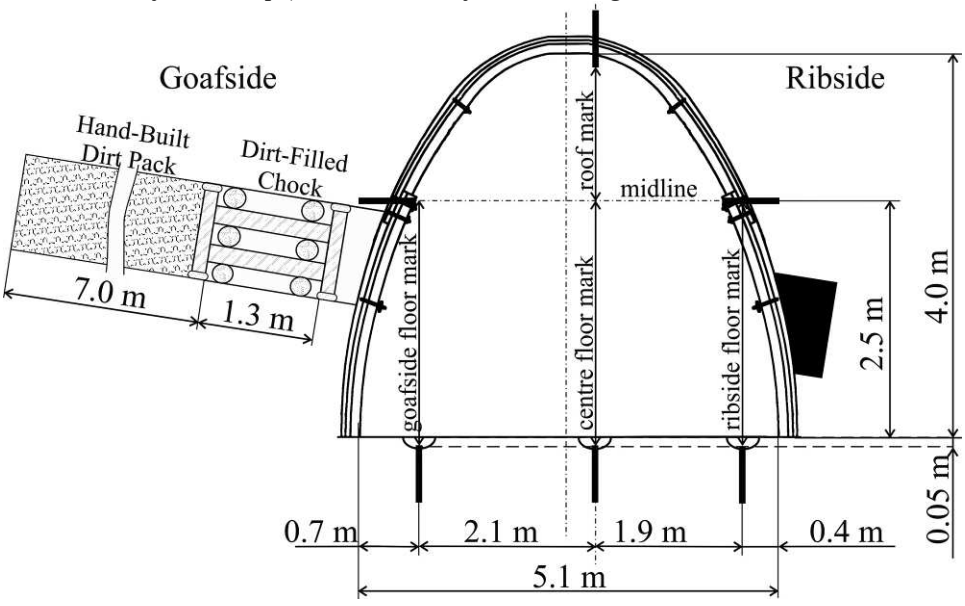

Figure 4. Marks measure scheme of monitoring stations in the belt entry

Measurements were carried out in series twice a week. At the same time, floor displacement was measured by using three floor marks. They were entry's goafside, centre and ribside.

Results were compared to choose the overall accuracy of the convergence between monitoring stations.

4. RESULTS OF MONITORING

The results of floor movement are given in Figure 5 in terms of displacement and its rate depend on the face distance. Calculation rate of displacement was adjusted taken into account the face advance by 50 meter per month.

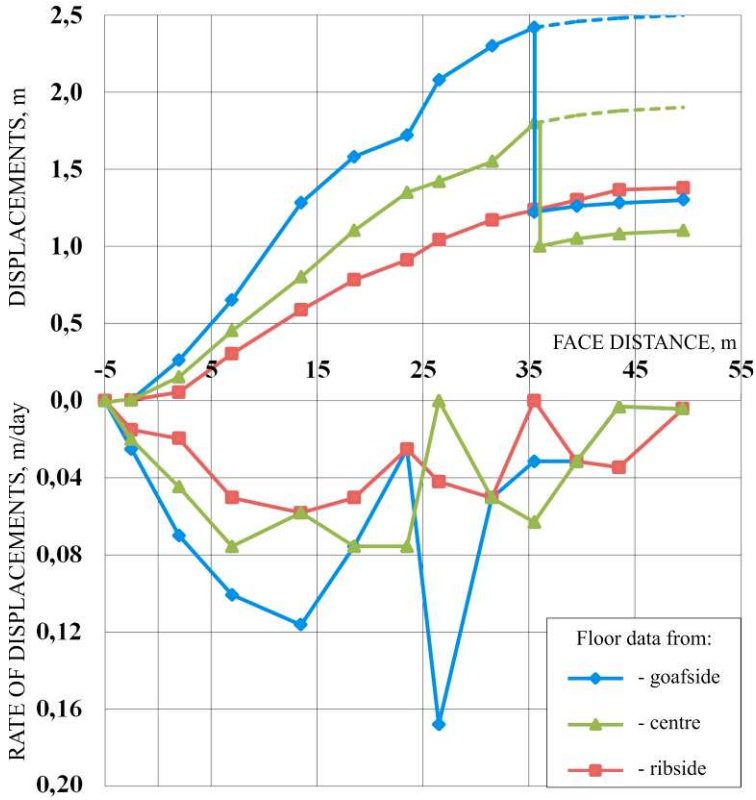

Figure 5. Floor movement and its rate depeding of face distance (a dotted line shows extrapolation data after ripping).

The graphs show that a floor movement increases in the rate of displacement along the face distance and slowdowns up to 35 m. The lifted floor is nonuniformed in width peak of about: 2.5 m from a goafside; 1.8 m in the centre; 1.3 m from ribside.

It is necessary to notice that the ripping was carried out at a distance of 35 m from longwall face. Its size was 0.8-1.2 m for the half distance wide from entry's goafside, but the ripping was not made from entry's ribside. Three marks were repeatedly installed onfloor.

5. ANALYSIS OF RESULTS

The results of monitoring made it possible to determine that the floor heave was carried out according to four stages.

At the first stage, some breaks and haves, producing numerous cracks were observed after the drivage of immediate floor. Floor displacement rate progressively increases nonuniformly along the entry wide. Thus, we have an inclination that increases up to 9° (fig. 6A). The completion of this stage means a cavity with break-up of the entry's goafside floor from face advance at a distance of 7 m (fig. 7A).

At the second stage the increasing rate of floor displacement from a goafside is established. There is an invariable in the centre and from a ribside as well. An angle of the floor inclination increases up 10° to 25° at this stage (fig. 6B). An intensive extrusion of the immediate floor (in some parts with break-ups) (fig. 7B) was observed on some sites starting from 7 to 25 m of face advance.

At the third stage (fig. 6C), there is a jumping rate of floor displacement from the face distance 25-35 m. Its maximum is 0.168 m/day. Thus, a view displacement of the floor stratum with creation of longitudinal asymmetry incurvation at a distance of 0.8-0.9 m from the goafside was observed (fig. 7C). Its vertical axis is tilted towards a goafside at an angle 35-50°. Floor displacement rate gradually decreased after the maximum achievement.

The fourth stage (fig. 6D) begins at about 35 m from face advance and the entry does not satisfy with safety rules. Thus, it is made with the help of ripping and retimbering where necessary (fig. 6E). After that, insignificant growth at a rate of floor displacement is stabilized.

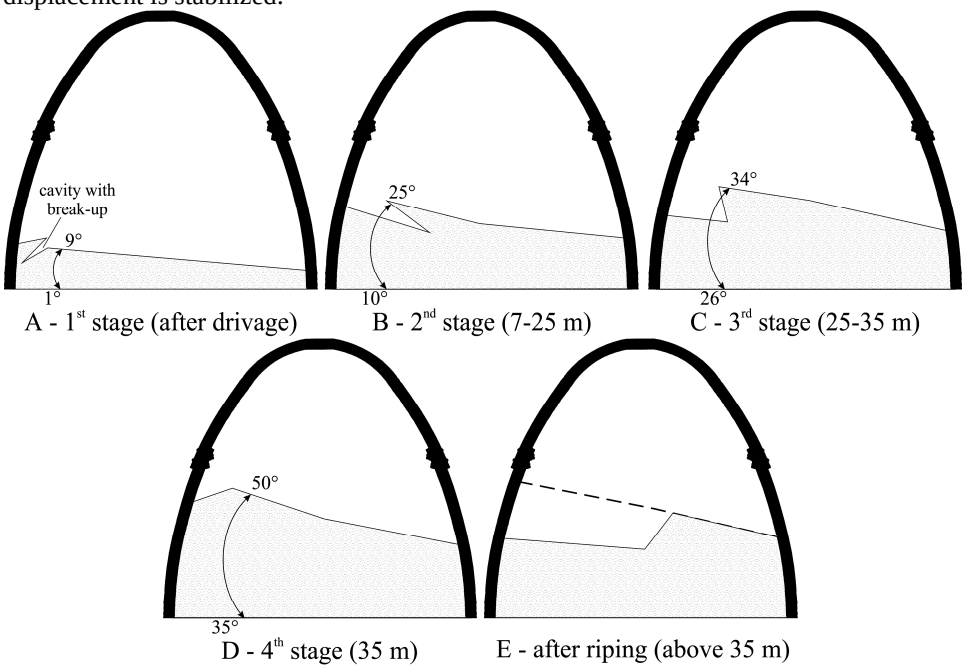

Figure 6. Floor heave in stages (a dotted line shows a size before ripping)

A- 7 m from face advance

B - 14 m from face advance

C - 35 m from face advance

Figure 7. A photograph shows features of floor heave in Abakumov Mine

6. CONCLUSIONS

Results of this study in condition of Abakumov Mine were revealed that floor heave has occurred through four stages. They have been divided by features of floor movement and its deformation.

It is established that floor heave occurs with a longitudinal asymmetry incurvation which vertical axis is tilted towards the goaf at an angle 35-50°.

The adopted protection support methods at Abakumov Mine do not provide the belt entry of the 8^{th} western longwall m_3 coalbed with stability.

Thus, it is more likely that the floor has to deform in order to establish hard rocks such as limestone and sandstone. It is unclear how a failure mechanism works in the floor structure to the extensive floor heave that results a hard stratum. In our opinion, it happens because of the anchorage between a pack and a hard stratum of limestone. Otherwise it would be hard to explain the cavity with break-up.

For better understanding, a further research will be focused on the reasons and developing protection support methods for controlling floor heave. Study will be carried out in order to keep the floor displacement in the acceptable limits in accordance with safety rules.

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