FASTENING AND MAINTAINING MINE WORKINGS IN THE ZONE OF HIGH TECTONIC STRESS

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Abstract: In the world at development of mineral deposits there is a steady trend of natural increase in development depth. Under the influence of these forces acting on a global scale in the earth's crust, qualitatively new conditions arise as in the manifestation of the natural field voltages, and in the corresponding design schemes. Due to this it is necessary to pay special attention to solving issues of ensuring stability of mine workings.

Key words: mining pressure, calculation, mine tunnels, rock, mechanical properties, geomechanical processes, deformation of rocks,

INTRODUCTION

According to the available materials and research results, in most cases, reinforcements quickly lose their load-bearing capacity, not because of the large amount of loads in the mine solder, but because of the significant unevenness of their distribution along the contour of the reinforcement and the length of the mine solder, asymmetry and others. [1]. From the analysis of the pressure curves, it was concluded that under the influence of such uneven loading, large bending moments affect the elements of the reinforcement due to undesirable deformations in the outer plane of the reinforcement.

The distribution of loads along the mining site is presented in Figure 1 [1]. As can be seen from the presented graph, the load on two adjacent frames is not the same, and the value of the load on the adjacent frames can differ several times. Such an uneven distribution of loads on the reinforcements along the mine field is caused by the non-uniform densification of the filling material, the presence of surrounding rocks and different rock types, the difference in the mechanical properties of the individual frames of the reinforcement, the inconsistency between the working moments of the shackles that ensure the flexible mode, unsatisfactory loading. explained by structure and other factors.

METHODS

Based on the conditions of the "Kyzil-Olma" mine, it was determined that the loads on the reinforcements are much smaller than the loads in their technical characteristics, according to the results of indirect calculations. One of the main reasons for the failure of fasteners in this way is the inconsistency between the working moments of the clamps that provide the flexible mode. In order for rear frame reinforcements to perform their "task" adequately, it is required to follow certain procedures during its installation and subsequent operation. These are implemented with flexible mode monitoring and control. The compatibility between the torques of the fasteners, which ensure the flexible mode of the stabilizer, is carried out by controlling the tightening force of the nuts on it.

As a result, the plane of impact of the load deviates from the central plane of the frame, so that the reinforcement elements are subjected to longitudinal compression and bending along with bending in the plane of the frame.

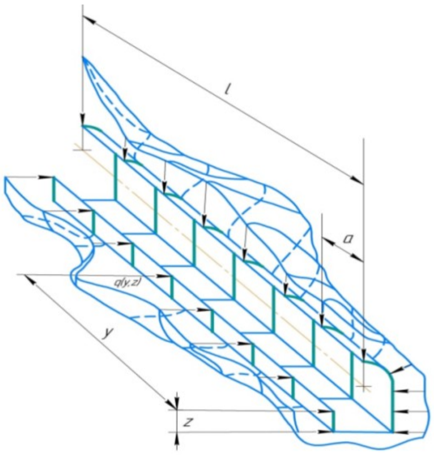

Fig. 2. Notex distribution of loads along the mining site

Additional torsional and bending moments increase the stress state significantly in steel thin-walled profile stiffeners, which are especially unstable against torsion. Observations show that under difficult conditions, metal reinforcement loses its load-bearing capacity very quickly in spatial bending-twisting deformation. This characteristic of the loss of the load-bearing capacity of the reinforcement is confirmed by the available materials in a number of research studies [2].

When fastening the bolted clamps that connect individual joints in the back frame reinforcements, the torque on the nut wrench is determined by the following formula:

$$M_{kl}=P_{kl}L_{kl}. \qquad (1)$$

This torque is applied to the nut and is used to overcome the friction between the side surface of the nut or washer (Mg) and the supporting surface of the part to be attached and the resistance in the groove (Mr):

$$M_{kl}=M_{tor}=M_g+M_r \qquad (2)$$

In the following years, high-strength bolts (σ_{sj}= 1800-2100 MPa) became widespread, and they work only in shear stress. The tensile stress for them should not exceed 400 MPa [3].

For ideal threaded connections (the thread and the side surface of the nut without friction), the torque in the key is determined by the following formula, and this torque is completely spent to overcome the angle of inclination of the thread:

$$M^r_{kl}=F_o P/2\pi, \qquad (3)$$

bu yerda, P – rezba qadamining o‘lchami, mm.

Odatda kalitdagi momentning oz qismi rezbaning qiyalik burchagini yengish uchun va asosiy qismi esa ishqalanish kuchlarini yengishga sarflanadi.

Tadqiqot natijalariga ko‘ra, ishqalanish koeffitsiyentining odatiy f_{tr}=0,15 qiymatlarida kalitdagi dastlabki momentni baholash quyidagi formula bilan aniqlanadi:

here, P is the size of the groove step, mm.

Usually, a small part of the torque in the key is used to overcome the inclination angle of the thread $M_{kl}^{r}=(0{,}05-0{,}15)M_{kl}$, and the main part is spent to overcome the frictional forces.

According to the results of the research, the estimation of the initial torque in the key at typical values of the friction coefficient ftr=0.15 is determined by the following formula:

$$M_{kl}\approx 0{,}2F_{o}d, \qquad (4)$$

bu yerda, d – rezbaning ichki diametri.

Tortishdagi kuch tortishdagi kuchlanish ifodasi orqali aniqlanadi.

here, d is the internal diameter of the groove.

Tensile strength is determined by the expression $\sigma_0=0{,}6\cdot\sigma_t$.

$$F_{0.}=\frac{\sigma_0\pi d_1^2}{4}=0{,}6\,\sigma_t\pi\,d_1^2/4, \qquad (5)$$

here, , $\sigma_0-¿$ tensile stress, $\sigma_0=0{,}6\cdot\sigma_t$; _t;

σ_t – yield strength of steel (for bolt material), MPa;

d_1 – outer diameter of the thread, mm.

RESULTS AND DISCUSSION

By monitoring the compressive strength of the clamps connecting the reinforcement frames, it is possible to control the "reinforcer-rock massif" system.

In the conditions of the "Kizil-Olma" mine, taking into account the influence of weight from q=220 kN to q=260 kN on one reinforcement frame in the preparation mine solders, the normative amount of the bolt pulling force in the clamps was determined by formula (4). According to it, when the dynamometer reading is $P_{kl}=0{,}115$ and the length of the key $L_{kl}=0{,}5$ m, the bolt pulling force is $F_o=20{,}51$ kN, and under the influence of this force, the mutually touching surfaces of the rear frames The friction F_{ish} work force generated between.

$$F_{ish}=\mu N_{bos}=\mu(4F_o+\frac{q}{2}) \qquad (5)$$

here, m is the coefficient of friction between the surfaces in contact with each other, usually $\mu=0{,}4-0{,}6$.

If we substitute formula (4) instead of F_o in formula 5 algebraically, we will be able to control the friction force between the surfaces of the rear frames in contact with each other through F_ish dynamometer indicator P_{kl} (formula 6).

$$F_{ish}=\mu(4\frac{\pi L_{kl}}{0{,}4d_1}P_{kl}+\frac{q}{2}). \qquad (6)$$

The fact that the tensile force of the yoke bolts on both sides of the arch frame reinforcement is of a standard uniform amount increases the flexibility of the arch frames and ensures that local loads do not appear along the contour of the reinforcement. Due to the displacement of the weakened array around the mine solder, it creates loads in the reinforcing elements.

In the conditions of the "Kizil-Olma" mine, after passing mine solders by the BP method, it was determined by visual observations that the distance between the massive contour around the solder and the reinforcements (zatyazhka) is from 4-7 cm to 32-38 cm, depending on the formation of the solder contour. . Naturally, a certain part of the contour of the massif around the mine solder, located at the closest distance to the reinforcement (reinforcer frame or zatyajka), is the area that generates local (point) loads. Usually, the contour of the massif around the deposit and the space between the reinforcements are filled with rocks of different sizes. The possibility of distribution of local (point) loads generated as a result of the analysis of the literature on rock mechanics [5] over the entire contour of the reinforcement through the volumetric deformation of the filled rocks was studied. Accordingly, research was conducted to reduce the increase of local (point) loads occurring in individual elements of the reinforcement and distribute them over the entire contour of the reinforcement.

By controlling the granulometric composition of the filling rocks, as a result of the interaction of the "Reinforcer - rock massif" system, the directions for changing the amount of deformation of the Fill massif were determined. 4 different sizes of rocks with a volume of 0.3 m3, granulometric composition of 20-40 mm, 40-60 mm, 60-80 mm and 80-100 mm were taken for the test experiments. These 4 rocks of different sizes were individually subjected to a constant pressure of 12.0 MPa for 2 hours each (Fig. 3).

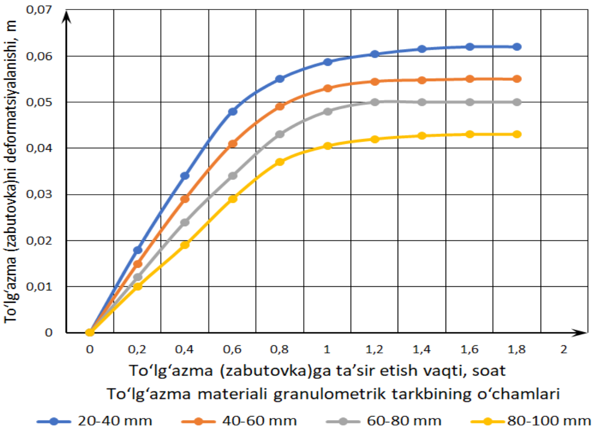

Fig. 3. Time dependence of the deformation of the backfill rock

The distance between the reinforcement and the contour of the rock after receiving the deformation characteristics of the filler rock materials with different granulometric composition, the amount measured as a result of blasting in underground clays, and the average size calculated by the method of mathematical statistics. was selected. In this case, the use of two types of filler materials in order to ensure the deformation of the contour of the rocks, the displacement and consolidation of certain filler materials under the influence of different pressures, and the uniform initial load on the metal arch frame reinforcement will give positive results. a conclusion was made: The lower part of the space behind the reinforcement to be filled with filler materials (approximately 0.3-0.5 part of the height of the solder) The granulometric content of the filler materials is 60-80 mm if it is filled with the size group, and the rest of the space is preferably filled with the size group of 40-60 mm granulometric composition.

As can be seen from the nomogram above, it was possible to reduce the pressure in the reinforcement by up to 30% by using the monitoring and control of the stress value of the flexible part of the metal reinforcement with a special profile and by filling the space behind the reinforcement with certain deformation characteristics.

CONCLUSION

Radial tensile stress appears in the bulging zone of the mine solder contour. As the rock is generally low in tensile strength, rock bursting, and in some cases rock "eruption" is observed in these places.

Manifestation of tectonic stresses in the "Kyzil-Olma" mine was recorded in a dynamic form in the form of failure of mine reinforcements, mine pressure in the ceiling part of the underground seams, in the form of hanging rocks. Deformation of the contour of the mine slab occurred mainly on its sides.

By monitoring and controlling the stress value of the flexible part of the metal reinforcement with a special profile, and using the filling of the space behind the reinforcement with certain deformation characteristics, it was possible to reduce the pressure in the reinforcement by up to 30%.

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