EXAMINATION THE MINE SHAFT EXPLOITED IN DIFFICULT GEOLOGICAL CONDITIONS

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The considered trunk of mine is operated the 40th years of the 20th eyelid in difficult engineering-geological conditions. At construction because of damage of a trunk of mine it was flooded. Therefore in the range of high-rise marks of +108,5 m – +80,7 m are executed strengthening and there was diameter reduction with 4,0 to 3,4 m. Because of long operation of a trunk of mine in difficult engineering-geological conditions there was a need of determination of its reliability for the most dangerous intervals. The condition of a trunk of mine was determined by results of complex inspection in the intervals executed from a brick, concrete, pig-iron elements and concrete. At inspection the technique was applied fulfilled and checked earlier on trunks of similar mines.

In the course of work inspection of a trunk of mine is executed from pig-iron elements and concrete. The analysis intense the deformed condition of elements of a trunk of mine on the measured tension is carried out. Sizes of pressure in characteristic intervals are determined by depth. The forecast of its constructive safety is executed. Level of operational reliability is defined.

Assessment of engineering-geological conditions

The Precambrian ore and crystal metamorphic educations blocked by friable fanerozoysky sedimentary breeds take part in a geological structure of a field.

Physicomechanical properties of breeds of friable thickness.

Breeds are presented by lessovidny loams, chalk, sand and sandy clays. Their properties are defined by dispersion, addition density, density of mineral part and natural humidity.

Loams lie in the range of high-rise marks of +179,6 m – +169,8 m. Power makes 9,8 m. Loams have the following indicators of physical properties: density is from 1,81 to 1,95 g/cm3, natural humidity from 19 to 23%, porosity from 31 to 41%. Standard values of strength indicators at shift tests have the following values: corner of internal friction - 28o, specific coupling of-16,5 kPas. The deformation module at the killed state makes - 24,6 MPas. Strength of loams on monoaxial compression changes from 0,14 to 0,17 MPas.

Chalk lies in the range of high-rise marks of +169,8 m – +125,9 m. The general power makes 43,9 m. Values of physical indicators following: density is 1,96 g/cm3, humidity of 20%, porosity of 38,9%. Strength and deformation indicators have the following values: corner of internal friction - 20,7o, specific coupling - 53,14 kPas, the deformation module when soaking - 33,7 MPas. Durability of cretaceous breeds on this layer changes ranging from 2,31 to 2,67 MPas at standard value of 2,46 MPas.

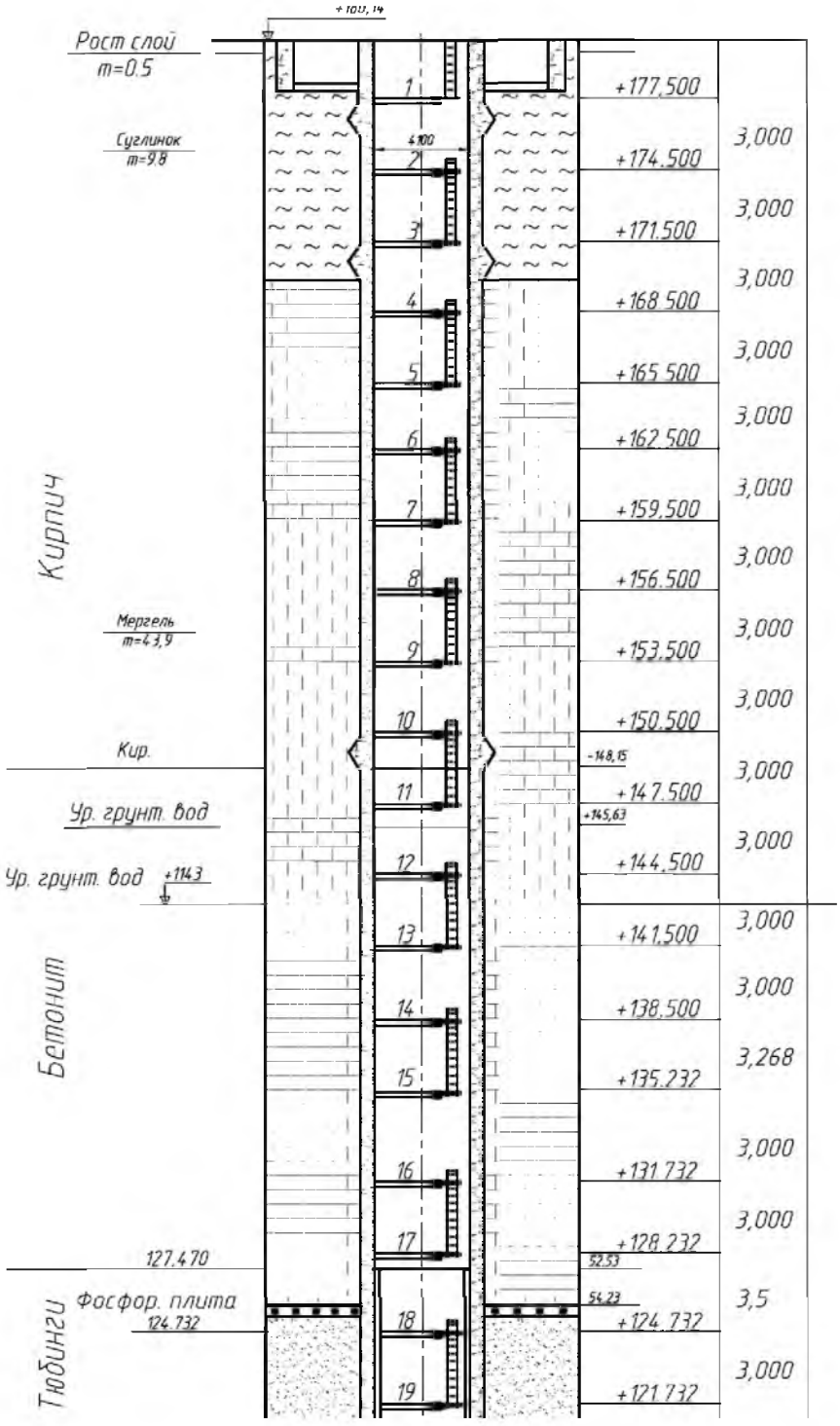

Fig. 1: Section on a trunk in an interval of high-rise marks of +180,140 m – +121,732 m

In the basis of cretaceous deposits in the range of high-rise marks of +125,9 m – 124,9 m lie the fosforitovy plate presented by strongly jointed semi-rocky breeds. Power of a fosforitovy plate makes about 1,0 m. Physicomechanical properties are characterized by the following indicators: density is 2,23-2,30 g/cm3, humidity of 3-7%, porosity of 15-18%. Strength indicators are defined at tests for monoaxial compression and stretching. Durability of breeds has the following values: corner of internal friction – 33o, specific coupling – from 7,1 to 8,4 MPas.

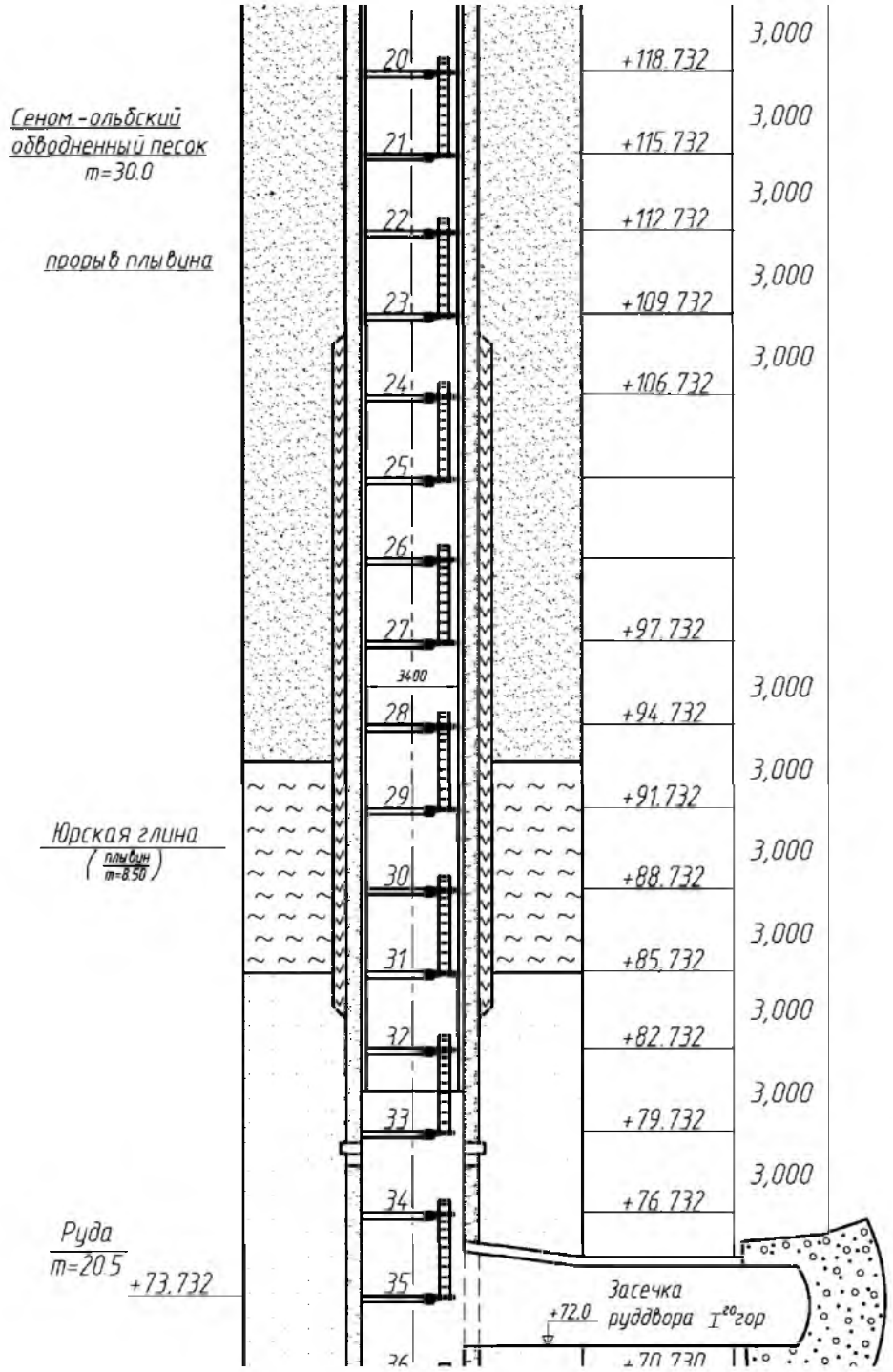

Fig. 2: Section on a trunk in the range of high-rise marks of +121,732 m – +73,732 m

Sand the quartz brownish-gray fine-grained lies in the range of high-rise marks of +124,9 m – +94,9 m. The general power of sand makes 30,0 m. Density of sand changes from 1,75 to 1,86 g/cm3, at standard value of 1,81 g/cm3, humidity from 15 to 20%, porosity of 41-42%, filtration coefficient from 2,2 to 7,6 m/days. Standard values of strength properties following: corner of internal friction – 30,5o, specific coupling – 0,5 kPas. The deformation module – 26,0 MPas. Taking into account dispersion of granulometric structure and water saturation of this thickness sand are inclined to an oplyvaniye.

Clay the dark gray sandy lies in the range of high-rise marks of +94,9 m – +86,4 m. The general power of clay makes 8,5 m. Standard values of the main water and physical indicators following: density is 1,95 g/cm3, humidity of 20%, porosity of 39,7%, filtration coefficient - 0,007 m/days. Standard values of strength and deformation properties have the following values: corner of internal friction – 9,3o, specific coupling – 40,67 kPas, the deformation module – 26 MPas.

Physicomechanical properties of breeds of rocky thickness.

Ore martitovy lies in the range of high-rise marks of +86,4 m – +65,9 m. Power makes 20,5 m. The main standard physicomechanical indicators have the following values: density – 3,21 g/cm3, a corner of internal friction – 37,8o, specific coupling – 6,33 MPas, the elasticity module – 43,0 GPA, Poisson's coefficient – 0,32, the module of comprehensive compression – 39,8 GPA.

Quartzite lies in the range of high-rise marks of +65,9 m –-128,0 m. Power of quartzites makes 193,9 m. The main standard indicators have the following values: density – 3,36 g/cm3, a corner of internal friction – 41,3o, specific coupling of 25,0 MPas, the elasticity module – 113,15 GPA, the module of comprehensive compression – 67,4 GPA, Poisson's coefficient - 0,22.

Hydrogeological characteristic

The field is in a zone of the broken mode of underground waters due to drainage located glad pits and operating water intakes. The water-bearing horizons are:

1. Modern alluvial water-bearing horizon;

2. Turon-konyaksky water-bearing horizon (K2t-k);

3. Alb-senomansky water-bearing horizon (K1-2al-s);

4. Jurassic water-bearing complex (J2-3);

5. Archaean and Proterozoic water-bearing complex (AR-PR1).

Technique of inspection of a condition of a trunk of mine

Vertical trunks of mines belong to one of the most difficult objects of the mountain enterprises. It is caused by lack of direct availability to tool control of their state. Works on inspection of trunks of mines are labor-consuming and difficult.

Inspection of operated tables of mines is made, generally on indirect signs. Completeness of inspection depends on availability degree. Examination of a trunk of mine was conducted in the following order:

1 . External survey of sites.

2 . Determination of the geometrical sizes of a design.

3 . Definition of elastic characteristics of materials.

4 . Determination of corrosion activity of concrete.

5 . Determination of tension.

6 . Reliability forecast.

External inspection of sites performed for the purpose of scoping of works and a choice of techniques of an assessment of tension.

Determination of the geometrical sizes of a design included: measurement of radiuses (diameters), curvature, identification of destructions, profiling of a wall of a trunk. The fullest

data are obtained proceeding from values of radiuses. The form and size of average radial loadings was determined by them.

Definition of characteristics of materials it was made proceeding from concrete and cast iron brands. The brand of cast iron was determined by project documentation. Definition of characteristics of concrete was made on the selected samples. Thus the filler type, communication of filler with cement, existence of a time and microcracks in a cement stone were defined. Elastic characteristics were defined by an acoustic method. Determination of corrosion activity of concrete made research of a condition of cement.

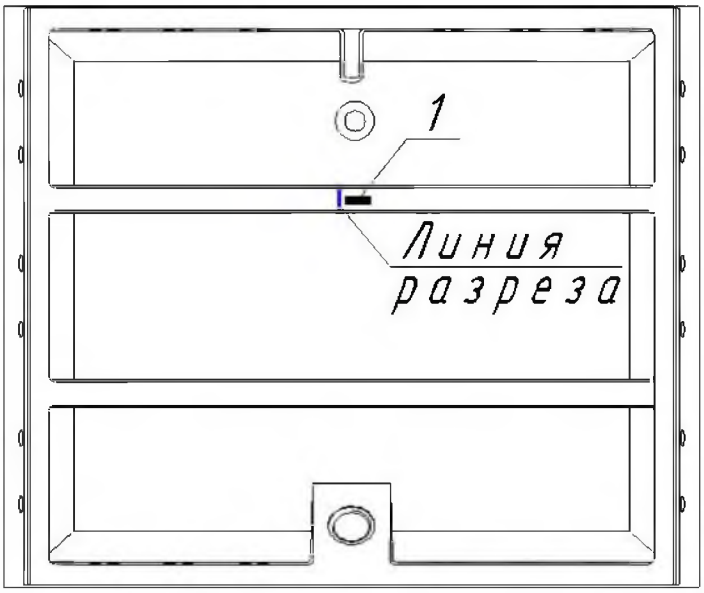

Fig. 3: Scheme of determination of tension method of partial unloading: 1 – strain gage

Tension in pig-iron walls decided by a method of incomplete unloading on use of strain gages [6]. The essence of a technique consists in a unilateral kickback of a pig-iron wall on a place with the pasted strain gage (fig. 3). The researches conducted by us showed that at a unilateral kickback of a pig-iron wall to the fixed strain gage there is its unloading of equal 50-60% of the full. For example, in a ring edge at partial unloading value of deformation equal $\varepsilon\theta$ = 210x10-5 is received, and at full unloading (I drank from two parties) – $\varepsilon\theta$ = 350 x 10-5.

In figure 4 the technique of the kickback which has been carried out in a trunk is shown.

Fig. 4: Photo of a pig-iron wall of a trunk with the strain gage after application of a method of partial unloading

On the measured tangential deformations tension is determined by Hooke's law:

$$\sigma_\theta = E_{чуг} \cdot \varepsilon_\theta \qquad (1)$$

where $E_{чуг}$ – the module of elasticity of cast iron, MPa;

ε_θ - the measured relative deformations.

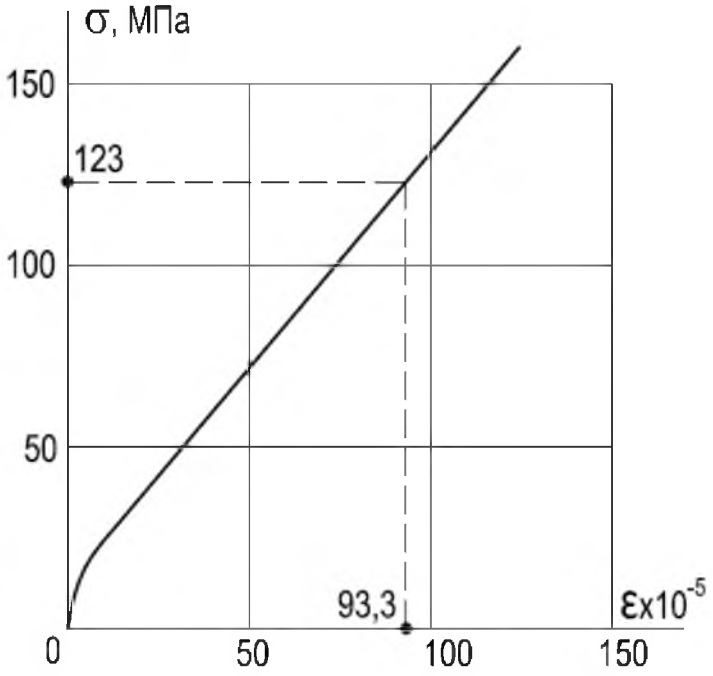

Fig. 5: The chart "σ-ε" for gray cast iron

Definition of the module of elasticity of cast iron on dependence of σ=f(ε) for gray cast iron see figure 5.

Sizes of pressure upon an external contour are determined by the measured tension by a technique of the Prof. N. S. Bulychev [4].

In a trunk by this technique determination of tension at depths was carried out: 61,6 m – in the flooded cretaceous breeds; 76,6 m – in the sand sated with water; 84,0 m – in clays.

In the course of work examination of a vertical trunk of mine is conducted. The analysis of results of inspection and assessment of technical condition allowed to make the forecast of level of its constructive safety taking into account intense the deformed state. Following the results of work the recommendations which application will provide necessary level of safety were developed and will reduce influence of natural and technogenic factors on reliability flx a trunk at its operation in difficult mining-and-geological conditions.

References

[1] Interaction of massifs of rocks with крепью vertical developments. M subsoil, 1966, 314 pages of the Bus; G. A, Krupennikov, N. S. Bulychev, A.M. Kozel, etc.

[2] Having betrothed, YU.S., Ognev V. K. Poppel N. V., etc. Research of manifestations of mountain pressure in a vertical trunk deeply. Mine construction. 1976, No. 9, page 11-13.

[3] Methodical recommendations about carrying out natural supervision in the trunks constructed in difficult mining-and-geological conditions. Belgorod, VIOGEM, 1985.

[4] Bulychev N. S. Mekhanika of underground constructions. M, Subsoll, 1982, 272 pages.

[5] Kazikayev D. M., Sergeyev S. V. diagnostics and monitoring of a tension fix vertical trunks. M, Mountain book, 2011, 245 pages.

[6] Vlokh N. P. Obdelka tension from pig-iron tubings//Metrostroy. - 1990 . - No. 1. - Page 17-19.