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Development of Parameters for Numerical Modeling of Geomechanical Systems "Excavation - rock mass - support"

The airway drift of “Trudovskaya” mine of “DTEK” company was chosen as an object of research because of strong effect of rock pressure and water influence in the excavation. The main forms of rock pressure in the excavation are rock falling from the side and the roof, and intense swelling.

The main purpose of numerical simulation is to justify the parameters of the support systems of the excavations, which are exploited in the “Trudovskaya” mine. As a test model was accepted a model which reflects a real situation in the vicinity of excavation.

The simulation tool is the "Phase2" program, and a stepwise method was used for the reason that this technique gives more accurate results that are closer to reality.

The main objectives of research were: to create a model close to reality; to analyse the stress-strain state of the rock mass; to work out modeling parameters for the system of joint.

The model is presented by the excavation of an arch form with an installed three-tier arch from the special profile of SVP-27 with locks at the height of 3.5 m on both sides, installed at the fifth stage of the calculation. The rocks in the model are arranged in layers at an angle of 11 degrees. Layers parameters are presented in table 1, where: $G_{сж}$ – is compressive strength, MPa; k_c – is structural attenuation coefficient; E – is Young's modulus, MPa; μ – is Poisson's ratio

Table 1 – layers parameters

	Solid	***Capacity, m***	$G_{сж}$, ***MPa***	k_c	***E, MPa***	μ
Roof	*Aleurolite*	7.5	30	0.4	6.75×10^3	0.23
	Sandstone	12	32	0.3	11.5×10^3	0.21
	Argillite	4	25	0.3	5.9×10^3	0.23
Coal	*Coal*	1.1	23	0.4	3.6×10^3	0.16
Floor	*Aleurolite*	0.8	30	0.4	6.75×10^3	0.23
	Aleurolite	0.65	30	0.4	6.75×10^3	0.23
	Sandstone	2.5	32	0.3	11.5×10^3	0.21
	Aleurolite	6.85	30	0.4	6.75×10^3	0.23
	Argillite	12	25	0.3	5.9×10^3	0.23
	Limestone	3	90	0.9	4.6×10^3	0.21

The initial loading conditions were the initial stress field corresponding to a depth of 690 m.

Analysis of the results of calculations shows the following: in case where support was only arched three-tier compliant, rock pressure manifest in the form of swelling was up to 0.51 m, and rock falls from sides, especially from the right-hand part, was up to 1.26 m. System of joints was set by the selection method, taking into account their similarity to the actual one in the “Trudovskaya” mine and the maximum performance of the computer.

“Beacher” system of joints was set at the 1st step of calculation, rock fall from the right side was 1.14-1.23 m, and floor swelling was 0.45 - 0.56 m.

With “Blocky” system of joints, in blocky form, rock fall from right side was 1-1.2 m, and floor swelling was 0.3-0.45 m, which is much closer to the real values of the rock pressure manifestations in the “Trudovskaya” mine.

Thus, based on the results of the simulation, the following conclusions can be drawn:

The adequacy of the test task by observation in situ is provided by the following parameters:

- Model dimensions and boundary conditions
- Support modeling format
- System of joints modeling format.

The account of system of joints in the model was quantitatively expressed in the decrease in the manifestation of the rock pressure in right side up to 0.05-0.1 m, and in floor of excavation up to 0.06-0.1 m, which is much closer to the real situation in the “Trudovskaya” mine.

Further research should be aimed at approximating the model to the real one. For this, it is necessary to study in more detail and take into account the physical and mechanical properties of rocks, their cracks and loads acting on the support.