

# Determination of ultimate parameters of deformation and destruction in the Zhelezny open pit rock mass (JSC Kovdorsky GOK) according to the IBIS FM ground radar

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The increase in the planned sizes and depth of open pits results in a higher actuality of slope stability monitoring.

Slope stability monitoring is performance of various in-situ measurements to collect information on the current state of the rock mass and forecast of its future state, including a moment of transition to the ultimate state.

Prediction of the rock mass state is impossible to perform without determining the values of the ultimate parameters of deformation, the excess of which leads to destruction of the rocks composing the pit wall.

A widespread method of determining the ultimate deformation parameters is identification of empirical patterns obtained by analysing the in-situ observation results.

The most common observation methods for the rock mass state in open mining are geodetic methods. Today, for monitoring purposes specialists widely use GPS measurements, various tachymeters and light distance meters, levels, laser scanners, and interferometric radars.

The main advantage of radars compared to other monitoring methods is their ability to monitor the rock mass state during 24 hours under any weather, regardless of precipitation (snow, rain, hail, fog) or poor visibility in an open pit due to dust, exhaust gases, etc.. The high accuracy of measuring distances (0.1 mm) is an advantage as well.

Despite the fact that in foreign practice the radars have been used for a long time (since 2001), the first interferometric radar in Russia appeared in 2014 and was installed on the western side of the Zhelezny open pit of JSC Kovdorsky GOK.

Over the 5-year operating period, considerable statistical material has been accumulated and several different-scale collapses have been recorded. All these data allowed identifying the patterns of development of the rock mass deformation process, determining the ultimate parameters and developing a temporary instruction for observations and processing the results of measuring the deformations of the open pit slopes using the IBIS FM radar.

The instruction contains an order of actions to detect the rock mass areas with potentially hazardous deformations, as well as the measures providing the effective operation of the technology given and the actions of personnel when alarms are given.