Modelling for Roof Failure Analysis in an Underground Cave

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Abstract : Roof collapse is one of the problems with a higher frequency in most of the mines of all countries, even now. There are many reasons that may cause the roof to collapse, namely the mine stress activities in the mining process, the lack of vigilance and carelessness or the complexity of the geological structure and irregular operations. This work is the result of the analysis of one accident produced in the "Mary" coal exploitation located in northern Spain. In this accident, the roof of a crossroad of excavated galleries to exploit the "Morena" Layer, 700 m deep, collapsed. In the paper, the work done by the forensic team to determine the causes of the incident, its conclusions and recommendations are collected. Initially, the available documentation (geology, geotechnics, mining, etc.) and accident area were reviewed. After that, laboratory and on-site tests were carried out to characterize the behaviour of the rock materials and the support used (metal frames and shotcrete). With this information, different hypotheses of failure were simulated to find the one that best fits reality. For this work, the software of finite differences in three dimensions, FLAC 3D, was employed. The results of the study confirmed that the detachment was originated as a consequence of one sliding in the layer wall, due to the large roof span present in the place of the accident, and probably triggered as a consequence of the existence of a protection pillar insufficient. The results allowed to establish some corrective measures avoiding future risks. For example, the dimensions of the protection zones that must be remained unexploited and their interaction with the crossing areas between galleries, or the use of more adequate supports for these conditions, in which the significant deformations may discourage the use of rigid supports such as shotcrete. At last, a grid of seismic control was proposed as a predictive system. Its efficiency was tested along the investigation period employing three control equipment that detected new incidents (although smaller) in other similar areas of the mine. These new incidents show that the use of explosives produces vibrations which are a new risk factor to analyse in a next future.

Keywords : forensic analysis, hypothesis modelling, roof failure, seismic monitoring

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