Numerical Simulation of Dimension Effect to Deformation in the Cataclastic Medium Goafs Using UDEC

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Abstract. In cataclastic rock medium, goafs are the potential security hidden troubles in the mining process. The sort of goafs has the characteristics of the large deformation in roof rock mass. In order to predict the deformation of roof, the numerical method was used under the mining goafs. Using the universal distinct element code (UDEC), three working condition goafs with different sizes were carried out the numerical simulation tests. For three structure sizes, the goafs surrounding rock all displayed the above deformation characteristics. According to the difference of goafs structure sizes, the roof displacements reached a 19.11mm, 26.78mm, and 47.35mm respectively. The analyses for plastic zone in the three conditions showed that the holistic span of plastic zones changed with the goafs size; the plastic zones transfixed gradually in roof, and formed the caving zones at last. Regarding to deformation characteristics of different sizes, these measures were provided, such as a network anchor injection, the lateral filling, cement grouting, and so on. The research results showed that in the cataclastic medium, the sizes of goafs’ structure has an obvious impact on the deformation of surrounding rock; the deformation increases with the sizes gradually; the goafs treatment measures provided could effectively guarantee the safety of mine production.

Keywords: cataclastic medium, discrete element, deformation, goafs.

1 Introduction

Rock, especially the cataclastic rock is a discontinuous geological media, is a discontinuous, heterogenetic, anisotropic and non-linear natural geological body which is cut by a large number of bedding, joints and faults. As a result of the complexity of the cataclastic rock media, some numerical analysis methods, such as the finite difference
method, finite element method and boundary element methods [1,2], are commonly used by L. Jing (2003) and HU Jianhua (2005). However, they are often limited by small deformation assumption. To address the engineering problems of the rich and the large deformation of cataclastic and jointed rock mass, the actual results differ materially from the project. Underground structure in cataclastic medium, such as mining stopes and underground excavation cavern and the mass transit railway and tunnel engineering, its stability and deformation are influenced by the discontinuous surface. Therefore, using the numerical methods based on the assumption of continuity to study, it is difficult to meet the requirements of the construction and design. Discrete element method is particularly suitable for weak joints-rich surface and engineering problems of large deformation by a recent survey by WANG Weihua (2005), X.B. Zhao(2008), Sotirios S(2007), Xiao-gang HE(2008) and Yao-She Xie(2009) [3-7]. To model the response of discontinuous rock masses, Cundall (1971) and Cundall and Hart (1985) developed the discontinuum approach [8,9]. Discrete element modeling (DEM) offers the advantage of simulating block interaction through individual joints, and is particularly suited to examining the behavior of fractured rock masses during excavation. So the discrete element method has been widely applied in order to provide a theoretical basis for the analysis of the deformation of cataclastic and jointed rock mass by Yuli XIA (2007), Shen, A. King (2008), MA Fenghai (2001), WANG Guijun (2004), and Zheng Yungming(2002) [10-14]. However, the mining engineering, as a result of the existence of a large number of goafs, which have different shapes and size, forms a major mining hazards. In order to handle reasonably and make good use of the goafs, it is necessary to study the size effect of different goafs and to analyze the deformation law of goafs in cataclastic medium and dispose the basic measures which are conducive to the project.

2 Project Description

Gaofeng mine, due to historical reasons and coyoting mines indiscriminately, destruction and all kinds of pillars and security isolation pillars, leaves a large number of irregular goafs which have been -179m level by YAN Rong-gui (2003) [15]. No.105 mine body is mainly shallow mined by indigenous people. As a result, the size of goafs is different. With the exception of a small amount of overlap and transfixon, the rest are not too large and straight. The structure of mining area develops well, including series of folds and faults and the associated cracks by ZHOU Zhihui (2004) [16]. Main faults are as follows: Barry- Sn Longtoushan fracture zone, fracture zone between layers, the fracture in the northwest(vertical), north-east fracture(horizontal) and north-south fracture by DENG Jingcan (2001) [17]. The northern ore body is cataclastic structure and the length of sliding surface in the rock is less than 0.5m. Calcite veinlets are the major joints. Its length is more than 10m and its width is 1-8cm. The interval is approximately 1.5m with 25-30°. It is believed in the survey that there is a group of joints whose inclination is 25°and space is 0.5m and there are three groups of intermittent joints whose inclination is 65°with about 1.5m space. These two kinds of joints are the main joints in cataclastic ore body.