Retention Goaf Stability Influence Numerical Analysis on Existing Building

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Abstract. In order to study the stability influence of abandoned stope on existing surface constructions, this paper summarizes and analyzes the main controlling factors based upon one mine in Hebei province. This paper also details a qualitative and quantitative analysis utilizing the numerical simulation method. According to the numerical simulation, if the time is taken into account, the current empty stope would also threaten the surface constructions, thus the empty stope should be treated in time. It provides a scientific basis of emphasizing the necessity of treating the empty stope.

Introduction

Retention goaf is a huge complex structure excavation space which is accumulated in the process of recovery by mining companies because of not deal with on time[1-4]. Especially small and medium mining enterprises, poor ore body, production process rough, so it it easy to form a retention goaf.

Hebei province is one of the main iron ore producing areas, which is rich in iron mineral resources, because of high-intensity resource development for many years, the main iron ore producing areas in the formation of a large area of retention goaf. Not only to the exploitation of mining enterprises posed a serious security security risks, resulting in a large number of high-quality mineral resources not used effectively, but also remain empty areas to increase over time will cause collapse of overlying rocks, causing ground movement, ultimately affect the stability of the surface construction of building, to the disastrous consequences caused to nearby residents, a serious threat to people's lives and property, affect social harmony and stability. It is essential to the theoretical analysis, make quantitative and qualitative analysis to the stabilizing influence of retention goaf and surface buildings., in order to protection of life and property around mining areas and the safety of buildings.

The impact on Collapse of overlying strata and ground movement prediction and the mining of the building damage and other issues, coal companies have done a lot of work and concluded a lot of useful experience and achievements. Metal ore mining methods for different geological conditions and coal, based on the proposed coal strata and Prediction of Surface Movement is generally difficult for metal mines[5-8].

This article make a mine in Hebei for example, details a qualitative and quantitative analysis utilizing the numerical simulation method.

Project background

This paper based on four Qi Ying mining areas of Hebei Cheng de , Qi Ying four mining area started construction in 2005, put into operation in 2006, the main ore body mining Fe23, There are two mining ore body, It has been mined 346m, 323m and 303m three middle parts at 2010, mining method is belong to stope method, it is a tunnel ripping-type stope , transport within the roadway

layout in the vein, tunnel is stope, mining height of about 10m, 10m high columns around the top, as Figure 1 follows.

Qi Ying four mining area was constructed in 2005 when the ground situation is simple, no buildings and the railways, roads and other facilities around it, in 2007, the construction of the railway in the mining area at the south side of about 100 meter. Later gradually building a rural road, Zhou Village Park stage, mine offices, staff quarters, Zhou table village cultural centers, hotels table Zhou, Zhou and other public facilities in primary stage, in which weekly table Village Park, mining offices, staff quarters, weeks Table village cultural centers, hotels table Zhou, Zhou table primary school and other buildings, as figure 2 follows. After years of mining exploration, formation of a certain area of the mined area, although currently no gob caving phenomenon, But with the gob exposure time increases, ground pressure will gradually increased, each shaft and surface gradually threat the safety of buildings. Therefore it is necessary to details stability analysis and evaluation and existing mined area of building structures on surface, it was provide a theoretical basis to deal with retention goaf.
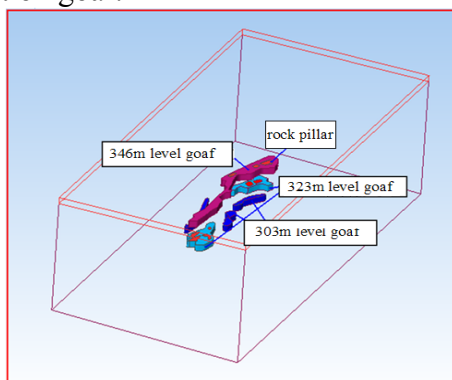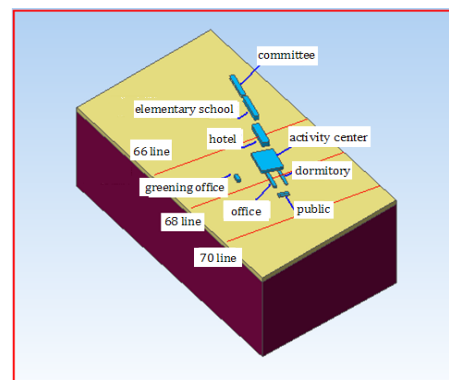

Fig.1 goaf situation of mine

Fig.2 surrounding environment of mine

Stability analisis

Numerical simulations. In recent years, computer software development, numerical simulation technology in engineering practice has been widely applied. The technology started to numerical simulation of rock movement on the basis of rock mechanical parameters, To quantitative analysis the degree of influence to the overlying rock[9-10]. This paper uses finite element software MIDAS / GTS numerical simulation software to simulated air movement on the surface deformation produced by the impact of building damage.

Model. This paper take use of finite element MIDAS / GTS simulation software , making three dimensional process simulation to the process of mining and surface subsidence over time . Mining three dimensional solid mesh simulations was shown as Figure 3, recovery ore grid simulation was shown as Figure 4. Model length is 600m, width is 300m, and the height is 210m, 148679 units.
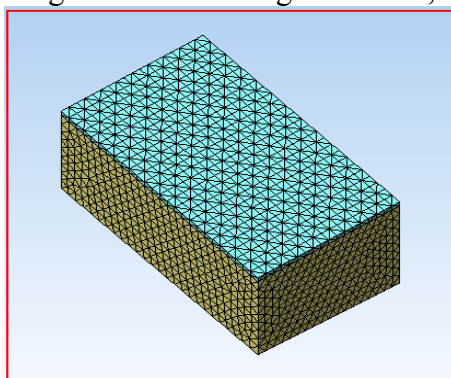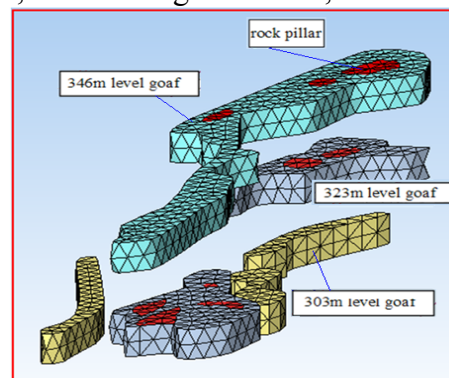

Fig.3 three dimensional grid model

Fig.4 three dimensional grid model of mine body

Simulations steps. Simulation steps, firstly, the calculation of the original rock stress, and secondly, for the step by step excavation forming underground mined area, Calculation of the formation status of cavity excavation in three steps, then the time effect model.

Calculation parameters. The simulation selected according to the geological detailed investigation report. Mechanical parameters were shown as Table 1.

Table 1 calculation parameters

name	$\gamma(kg/m^3)$	E(GPa)	μ	C(MPa)	$\Phi(°)$
ore	3300	4.8	0.21	2.4	38
rock	2700	4.31	0.22	2.29	36
topsoil	1600	0.015	0.25	0.01	32

Status goaf stability numerical simulation results and analysis. The results of this analysis to select the most direct surface displacement parameters for the evaluation indicator, the results was shown as Figure 5
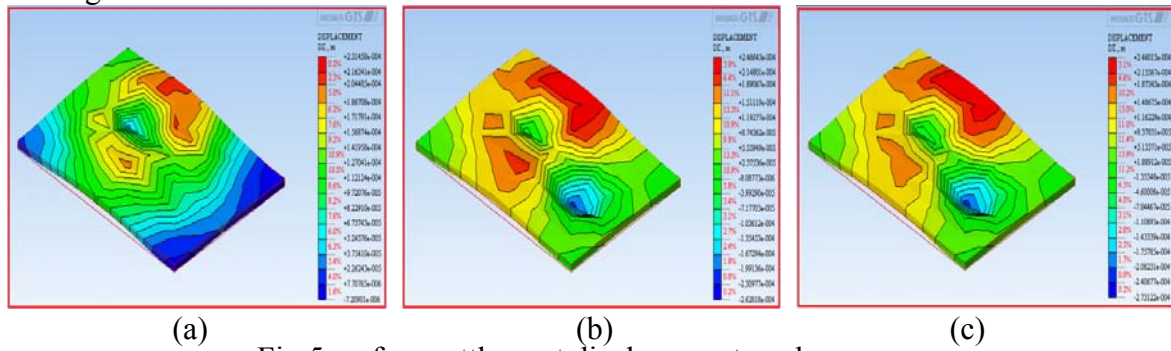

(a)   (b)   (c)

Fig.5 surface settlement displacement nephogram

Note: (a) The first level of excavation simulation results; (b) The second level of excavation simulation results; (c) The third level of excavation simulation results

Because the first level of the roof was more than 100 meters away from the surface, and the empty area is small, the first level has little effect on the surface after excavation, surface subsidence is only 0.007mm; the second level of excavation, along with the Mined area increases, the maximum surface subsidence was 0.27mm; the third level of excavation in the amount of surface subsidence was 0.26mm.

Timing effects simulation. Stability simulation results of Status gap, the current Gob little effect on the surface buildings, mine-site survey also confirmed this point, because of adopting the ideal simulation model, mechanical properties of rock around the ore body and the rock will be weaken because of the time effect. That over time, gob under the influence of the groundwater, geological movement, underground mining, rock blasting such factors the strength will be decreased. Therefore, the simulation of the goaf must be considering time effect. You use real-time simulation, hardware demanding, needing a large simulation time. This article by weakened the effect of rock parameter simulation time effect to the goaf. Select the same value as the sedimentation of surface displacement evaluation.
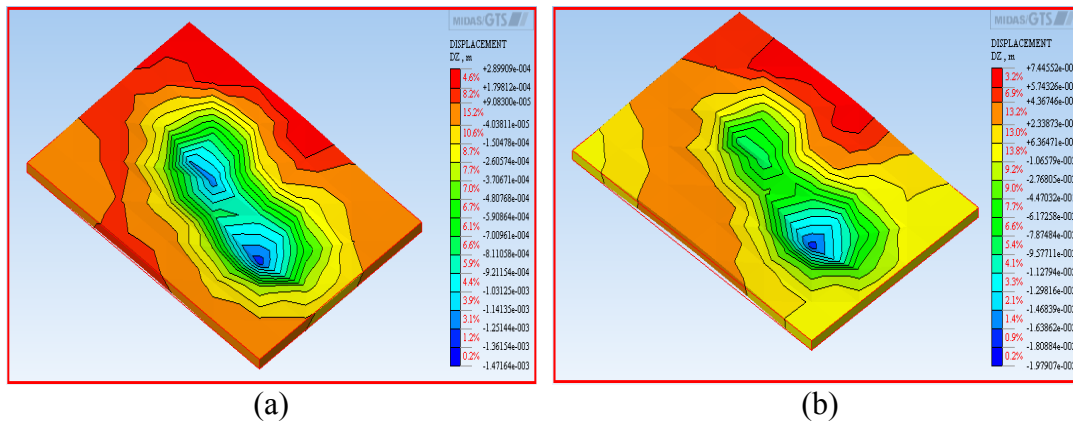

(a)   (b)

Fig.6 surface settlement displacement nephogram

Note: (a) rock mass strength 10%; (b) rock mass strength 40%

Rock mass strength reduction of 10% for the 1.5mm maximum surface subsidence, When the rock mass strength reduction after the 40% maximum of 19mm of ground settlement, Close to the alert of surface building settlement caused by underground excavation. (According to the relevant literature, underground excavation surface buildings settlement is 20mm alert). Existing mines goaf

will be a threat to the safety of surface buildings, so mine should be timely processing to the mined areas.

Summary

This paper maked a stability analysis of surface building to the Hebei Chengde Qi Ying four mining areas.

Obtained that under the evaluation of numerical simulation, mining existing gob factors in considering the time effect on the surface will be a threat to building safety, mine should be timely processing of mined areas.

This paper use numerical simulation methods, details qualitative and quantitative analysis to the stability of mining retention goaf and the building on the surface, and obtain satisfactory results. The results provide a scientific basis. were stranded in the mine's processing of mined areas need to deal with mine retention goaf.

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