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Application of a combined support system to the weak floor reinforcement in deep underground coal mine

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ABSTRACT

More and more coal mines begin to exploit deep resource, leading to more serious supporting problems. Common supporting measures for shallow roadways can hardly apply to the deep geological conditions, which are mainly reflected by high ground pressure, more broken and weak surrounding rock. This paper takes a winch room in China's Gubei coal mine as an example to study a new kind of combined supporting system for weak floor under adverse geological conditions. The stability of the winch room is simulated by FLAC3D. The deformation characteristics and stress distribution of the surrounding rock is obtained. Then, a new kind of combined supporting system as well as monitoring measures for the floor is proposed. A new type of hollow grouting cable which has many advantages is introduced in the supporting system. The results show that the combined supporting system is satisfactory.

1. Introduction

As the depleting of shallow buried resources, more and more coal mines in China begin to exploit deep resource, leading to more serious problems to the stability of roadway and chambers. Comparing with shallow strata, weak surrounding rock and high ground pressure are the typical characteristics of deep coal measure strata [1–3]. Taking Huainai Mining Area in China as an example, more and more mines' depth exceeds 800 m. Weak surrounding rocks, such as mudstone and sandy mudstone, are quite common in deep strata of this mining area. More than half of the deep buried roadways and chambers are threatened by large deformation and require repairs time and again. Floor heaving problem is especially serious in Huainai Mining Area because of the weak floor and high ground pressure. Repeated dinting process would not only obstruct normal production of the driving face, but also cause loosing effect to the roof and side wall. In recent years, Huainai Mining Area has carried out several special projects and trials to study new reinforcement measures applicable for deep mining and control the floor heaving problems. The presented work of this paper is part of these special projects, which aims at studying new kinds of supporting system for weak floor under high ground pressure.

The present reinforcement methods for roadway floor in coal mines can be generally classified into the following two types, reinforcement of the rock mass and unloading ground stress. The former contains bolting, grouting, inverted arch steel support, etc. The latter mainly refers to floor kerving which is generally applied to harder rocks under high ground stress [4–6]. By this means, the high stress in the superficial rock mass can be released and the high stress region be transferred to inner part of the rock mass.

In this paper, a new kind of reinforcement system for weak floor of a winch room in China's Gubei coal mine is present. Based on numerical simulation and comparative analysis, deformation mechanism of floor heave in deep rock roadway is studied. Then, a combined reinforcement system is taken to deal with the adverse geological conditions. A new kind of hollow grouting cable which has many advantages is introduced in the supporting system. The associate construction technique for anchor (cable) and floor grouting process are also proposed.

2. Failure of winch room in Gubei coal mine

The winch room of South wing 11–2 in Gubei Coal mine locates nearly 800 m below ground level, as shown in Fig. 1 (Site A). The

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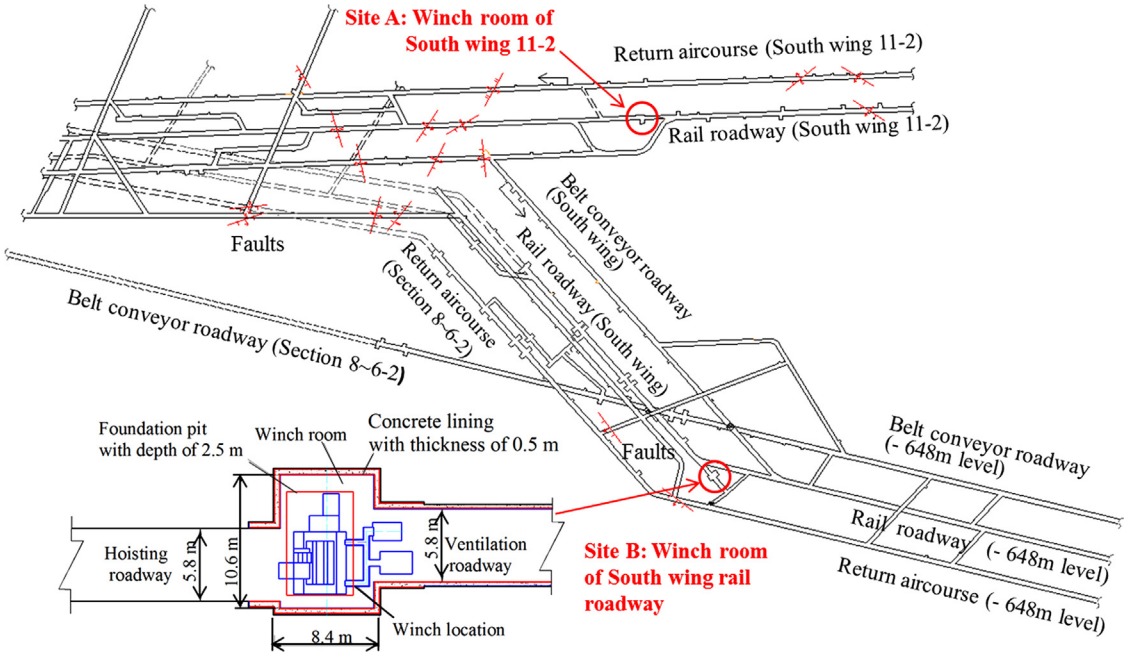

Fig. 1. Location and layout of the winch room.

Fig. 2. Serious floor heave and deformation of the winch room of South wing 11-2 in Gubei coal mine.

dominating rock types around this site are mudstone, sandy mudstone. Geological survey shows the tectonic stress is high and the surrounding rock is weak. The support measures for roof and side wall are mainly constituted by concrete lining, bolts (cables) and grouting, while the foundation pit is reinforced mainly by bolts. It is badly broken after excavation (about 8 months latter), as shown in Fig. 2.

Thus, the supporting and strengthen measures for this winch room is not appropriate to resist the adverse geological conditions such as high ground stress and weak rocks. The foundation of the winch has been inclined because of the non-uniform floor heave and operation of the winch is badly obstructed [7,8].

3. Geological conditions of winch room of South wing rail roadway

3.1. Stratigraphic characteristics

The winch room of South wing rail roadway in Gubei coal mine has quite similar Geological condition with the above one. As shown in Fig. 1, the two winch rooms are quite near to each other. The layout of the winch room and adjacent roadways is shown in Fig. 1. The dominating rock types of this winch room are mudstone, sandy mudstone, and thin coal seam. The winch foundation pit (with depth of 2.5 m) is located in the sandy mudstone (with