

Research of ground stress test of 5 plate area in Zhaozhuang Coal Mine

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Abstract. Ground stress is the most primary stress in earth's crust and not disturbed by engineering. In underground engineering, the fundamental cause of the deformation of surrounding rock is the influence of ground stress after the roadway excavation. Ground stress testing can provide basic design parameters for mining area. Using stress relief method to test ground stress in the 53101 roadway of 5 plate area in Zhaozhuang Coal Mine. Research results show that the maximum principal stress of the 5 plate area in Zhaozhuang Coal Mine is 13.41MPa, the dip angle is 5.76 degrees and the azimuth angle is N25 W, so Zhaozhuang Coal Mine belong to medium stress mining area. In order to reduce the influence of the stress on the stability of surrounding rock, the direction of the roadway is parallel to the maximum horizontal principal stress and the two gang was significantly affected by horizontal stress. In Zhaozhuang mine area, there exists the gravity stress field and the tectonic stress field, and the tectonic stress is dominant.

Introduction

Ground stress is the most primary stress in earth's crust which is not disturbed by engineering. In underground engineering, the fundamental cause of the deformation of surrounding rock is the influence of ground stress after the roadway excavation. Large numbers of production practice in the underground engineering have proved that the ground stress will not only damage surrounding rock and support, but also become the root cause of gas outburst and rock burst dynamic phenomenon. Therefore, the ground stress is the key factor to determine the stability of the surrounding rock. In recent years, with the gradual deepening of the research on the stress field in the mine, scholars have found that the research of ground stress plays an important role in the layout of the roadway, in the shape of the roadway section and in the form of support. Therefore, the ground stress measurement provide basic design parameters, can be of great significance in ensuring the safe production of coal mine. In this paper, the stress test of the 5 plate in Zhaozhuang Coal Mine is carried out, the analysis of ground stress data have important guidance significance to the stress distribution of the 5 zones of the coal mine and the stability of the surrounding rock.

Principle and method of ground stress measurement

In 1930s, the United States, Australia and some other countries carry out the work of original rock stress testing according to the needs of a number of projects. By analyzing the data of the stress test to understand the stress distribution in the mining area and guide the support design of the roadway, which has a positive effect on the scientific production planning. At present, there are more than ten

test methods of ground stress, and the measuring instruments are as many as 100 kinds. The main factor that affects the results of the stress test is the method of stress measurement and test equipment. The stress relieving method is the most mature method in the stress test at present.

The basic principle of stress relieving method is that when the rock is released from the rock mass affected by the original rock stress, it will have an expansive deformation, which is closely related to the original stress, and will show a regular distribution. The elastic modulus of rock was measured by measuring the three-dimensional expansion of rock. According to Hooke's law, calculate the magnitude and direction of the force before it was released, the force is the original rock stress. Specifically, we need to make a hole in the surrounding rock for the installation of stress sensor, then use the set of drilling equipment which is concentric with measurement hole for drilling core, realise the stress. We can calculate the magnitude and direction of the original rock stress by taking the difference before and after the test sensor as well as according to the formula.

Spot measurement of ground stress in Zhaozhuang Coal Mine

Selection of test sites. It is very important to choose the appropriate measurement point of the ground stress in the test, which has important influence on the accuracy of the test results. In general, the ground stress measurement points are chosen according to the following principles.

As far as possible to ensure the integrity of the surrounding rock of test site, to avoid the broken rock zone, fault and other areas;

As far as possible to avoid large chamber, as well as the excavation area and other regions which have been subject to stress perturbation;

The need to avoid the stress concentration of the roadway to ensure the stress measurement is carried out in the area of the original rock stress;

The test site should be distributed in different level in order to study the whole stress distribution of coal mine;

As far as possible to close to the target roadway of the research in order to reflect the original stress of the roadway in the most effective way and provide a theoretical basis;

Because of the need to play a deep hole, large enough space is necessary to accommodate large rigs in the test site in order to ensure the smooth progress of the testing process.

According to the above requirements, in order to obtain the more accurate ground stress data, taking into account the actual situation of the surrounding rock of the 5 plate area of the Zhaozhuang Coal Mine, it is determined that the ground stress measurement should be in the 5 plate area 53101 roadway.

Test procedure. The stress relieving method is used in the field of stress test of the 5 plate area in Zhaozhuang Coal Mine. In general, the main test steps in the field are shown in Fig. 1.

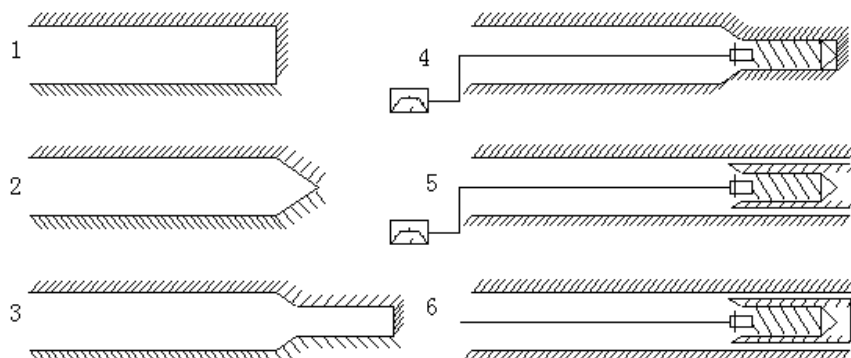


Fig. 1 Diagram of hollow inclusions strain method stress relief process

The main steps are as follows.

Hit the big hole: Carry out the drilling work in the selected ground stress measuring point, the design hole depth is 12M, the diameter is 130mm. At least 3~5 degrees are maintained from the angle of the drill hole, so that the water can flow out and clean drilling easily. Record the hole depth, Drilling structure is shown in Fig. 2.

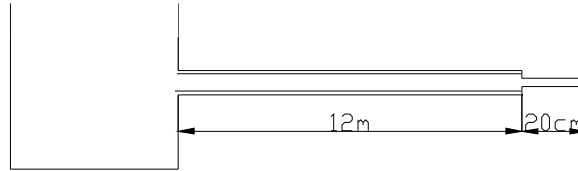


Fig. 2 Drilling structure diagram

Hit the small hole: After finishing the big hole, select burnishing bit to drilling bottom about 10cm, make the hole bottom become smooth plane, then use conical bit to drilling bottom and obtain frustum type hole which is linear transition from big hole to small hole, and then reuse small bit to drill installation hole, make the big hole and small hole in concentric state basically. Hit 20cm or so, after finishing the small hole, rinse with water, and then scrub with alcohol or acetone.

Install stress meter: Pour the distributed binder into the internal cavity of xenoliths stress meter, use pin to fix it well so as to prevent colloid outflow, then install it to the end of the director. Slowly push it into the big hole, then pay attention to the length of the record, the specific location of the xenoliths in the large hole. When the end of the body is about to enter the small hole, it will be more slowly to carry out the xenoliths stress meter. When the fixed pin was snapped then further promote 20cm to ensure xenoliths stress meter could be successfully installed to the small hole. At this point, we can measure the angle of the xenoliths stress meter by the directional instrument.

One day after the successful installation of the xenoliths, the stress meter and hole wall are cementation together, carefully and slowly pull out the directional instrument and installation rod from the big hole, puncture out the wire end of the xenoliths from core drill bits and drill pipe successively, then push the core drill bits and drill pipe to the bottom of the big hole. Record the position, so as to calculate the depth of the coring promote, connect the strain gauge with the conductor of the xenoliths stress meter to observe the value of the strain gauge, when its reading is stable, start drilling rig of coring and rescind drilling. At this point to carry out grading rescind, that is stopping drilling at 3cm each time, after the strain gauge is shown to be stable, then start the next 3cm drilling and rescinding, until the whole xenoliths stress meter is released and the number of the indicator is stable, which indicates that the whole xenoliths is completely released. Finally, take out the whole core including xenoliths, the test work is finished.

Using plastic wrap to cover the core which is just taken out, carry it to the ground and measure the elastic modulus and Poisson's ratio by rate definite instrument immediately.

Test results and analysis. According to the stress relieving data, the curve of the strain change and rescission distance of each strain gauge of the 53101 roadway in the 5 plate region are shown in Fig. 3.

Apply the special data processing software to process the data, the final processing of the principle stress of the 53101 lane as shown in table 1. The final principle stress of the 53101 roadway is shown in Table 1.

In order to comprehensively reflect and understand the actual state and distribution characteristics of the original rock stress in the underground coal mine of ZhaoZhuang, and combined with the underground construction conditions, roadway layout and geological conditions so that analyze the data of the 5 plane of 53101 roadway in the Zhaozhuang Coal Mine. The

maximum principal stress in the 53101 plane is 13.41MPa, with a dip angle of 5.76 degrees, and the azimuth angle is N25W. According to Heim hydrostatic pressure theory, the calculation of vertical stress should be 11.25MPa, the actual measurement of the vertical stress is 12.40MPa, and the results are slightly larger than the theoretical value. The maximum horizontal principal stress, the minimum horizontal stress, vertical stress.

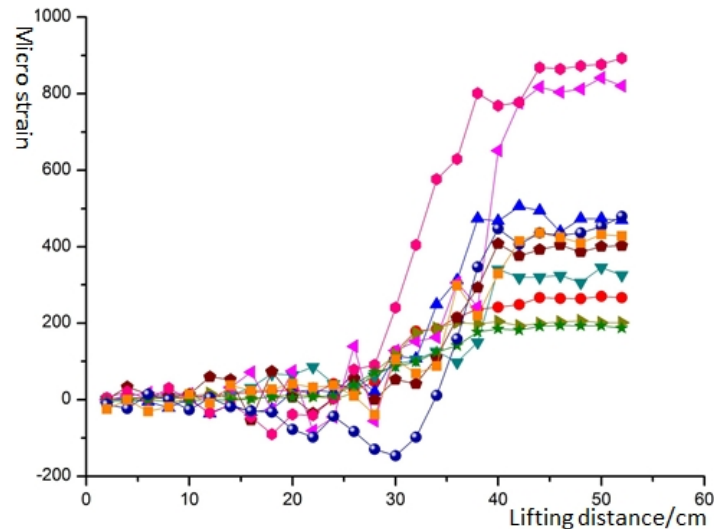


Fig. 3 curve of the stress relief in 53101 roadway

Table 1 Results of ground stress measurement of 53101 roadway

Principle stress	Measured/MPa	Elevation/(°)	Azimuth/(°)
σ_1	13.41	5.76	335.025
σ_2	12.40	89.09	89.38
σ_3	9.69	-0.70	179.34

Conclusion

Through the ground stress test of the 53101 plate in the 5 area of the Zhaozhuang Coal Mine, we conclude that:

The maximum principal stress in the 5 area of the Zhaozhuang Coal Mine is 13.41MPa, with a dip angle of 5.76 degrees, and azimuth angle of N25 W, so Zhaozhuang Coal Mine belong to medium stress mining area. In order to reduce the influence of the stress on the stability of the surrounding rock, the direction of the roadway is parallel to the maximum horizontal principal stress and the two gang was significantly affected by horizontal stress.

In Zhaozhuang mine area, there exists the gravity stress field and the tectonic stress field, and the tectonic stress is the dominant. Self-tectonic stress show great influence to the deformation and failure mode of the underground rock and the law of the mine pressure.

Reference

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