Controlling entry in soft rock with natural support strength, strikesill, etc.*

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Abstract Presented the concept of the natural support strength. The natural support strength, the strike sill, the multifunction retractors (developed by the author) and etc. were used with the technical measures to change the passive support to the initiative support, and the soft rock entry was supported. And its process is simple and less equipment is needed, and the cost is low and the advance rate is high, which can meet the requirements of actual mining. It solves many support difficult problems.

Keywords natural support strength, strike sill, multifunction retractor, soft rock entry

Introduction

The soft strata control around roadway is a world difficult problem in the mining engineering. Because the supporting roadway in soft rock is difficult and technical economic benefits are not good, thus underground mine fields or their some parts are not mined and abandoned abroad. The case is quite different and soft rock distributes widely in China. In coal mines alone there are more than 30 mining areas in which their soft rock roadway is very difficult to maintain. This problem has been a serious problem of the mine construction and production. The soft rock problem appeared in the construction of coal mine in China in 1958, and from that time the research on the soft rock started. In recent years, China’s coal mining range and depth increase gradually and high stress roadway in soft rock whose depth is above 600 m is distributed more and more extensively. While using the traditional bolt, U section steel, and etc. the way of supporting, their surrounding rock and supporting in several months were destroyed, seriously influencing the safety and production in the coal mine.

1 The bolt grouting support

Beginning from 1990s, Huaibei Coal Mining Company organized scientists to tackle the high stress soft rock roadway problems. It took the lead in going on the industry research and application in bolt grouting support in Linhuan Colliery, Qinan Colliery and other mines, and cooperated with Shandong University of Science and Technology, Huainan Coal Mining Company and China University of Mining and Technology, started the research and application on the mechanism and technology of bolt grouting support in high stress and extremely soft rock project. Through the 10 a research, experiments and application, scientists successfully solved multiple relevant theories and technological problems (won 2 national patents). This technical achievement was successively popularized and applied in 15 mining areas in China on a large-scale. The total length of bolt grouting supporting roadway was 175 000 m, saving as much as 490 million Yuan of funds. In November, 2001, in Qidong Colliery of Wanbei Coal-Electricity Company in Anhui Province mine flood suddenly happened, draining off water for 4 months. Under the circumstances the

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roadway with U section steel supported, bolting and shotcreting est. supporting way were all wrecked, while the main roadway of 680 m only with bolt grouting support was excellent without damage. This proves that the bolt grouting support can definitely solve the support problem in the soft rock development roadway, symbolizing that China has made the important breakthrough in the coal mine roadway support technology. At the national science-technology award ceremony that convened in 28 Feb., 2003, “the high stress and extremely soft rock project bolt grouting support mechanism, the engineering research and the application” the achievement that was completed by the HuaiBei Coal Mining Company with other three units cooperation, had the honor to receive second prize of the State Award for Scientific and Technological Progress.

The bolt grouting support is a kind of supporting method that aims at the broken situation that lies in the joint, crevasse growth and etc. fault crushed zone and surrounding rock is loose and slacking, using the bolt grouting technology, the surrounding rock structure is changed and its cementing power, the angle of internal friction and the surrounding rock integrity are enhanced, making roadway support enable to play its role fully. At present, there are several million meters of high stress and extremely soft rock roadway in the Chinese coal mine. The new technology using bolt grouting may be adopted in soft rock mass high side slope project harnessing, the deep hole excavated for building foundation and the high dam’s reinforcement, the soft adjacent rock’s large underground chamber and the tunnel supports.

Will the bolt grouting technology now be able to solve all the soft rock roadway support?

For this, a field experiment was made in the soft rock entry. The main part of bolt for grouting in the fore poling before the working face already lose efficacy at the scene. That is to say, the bolt grouting support in the soft rock entry being unable to withstand the impact of mining, can not be like the development roadway as to ensure safety and production, we must open a new path for more simple and economic soft rock entry support methods than the current combined supporting.

2 Entry in soft rock

2.1 Characteristics

The soft rock entry is different from the soft rock development roadway. First, the soft rock entry in the service period must receive the mining impact. Second, the servicing time is short, so, it is not suitable that the soft rock entry uses a high cost supporting method. One development roadway serves many districts (panels) and one district serves many coalfaces, therefore the development roadway service life is long, generally dozens of years or even more than 100 a. So cost per ton of coal is low, generally only about a few percent of the entry. In order to ensure long-term safety of production, for reducing a lot of the work-load and cost of frequent maintenance, it is cost-effective to spend a lot of money on driving support. And in soft rock because of the entry maintenance difficulties, coalface extraction is not easy, and recoverable reserves of one coalface are less, the presence and service time of the soft rock entry is short (usually about 1 a or less), and 2~3 entries only serve one coalface. If spending the same funds as development roadway (bolt grouting costs 7 000 to 7 500 Yuan/m, also grouting equipment is needed) for the roadway driving and supporting, the average cost of mining one ton of coal is high! Therefore, it needs another method to support. Third, the project soft rock has the remarkable plastic deformation and is influenced by mining directly, to avoid the surrounding rock destruction and large deformation in the soft rock entry is difficult. Obviously the soft rock entry support is more difficult than the soft rock development roadway. But the surrounding rock deformation and the destruction do not mean roadway expiring, the entry is not the permanent project, so long as the technology and economy is reasonable the safety work space in its lasting period is good, this must adopt each technological means to guarantee the safety and meet the production needs.

2.2 The supports used

Regarding the soft rock entry supporting, at the beginning, the coal mine used many kinds of single supports, mainly consisting of 2 categories with the exception of arch support(not suitable). One kind is steel support made of mine I-steel/the U section steel including the rigid support and the yieldable support. The other kind is all kinds of bolt supports, including bolting and shotcreting, bolt beam net, bolt cable and so on. In the situation in which the 2 categories of supports didn’t make the obvious technical and economical benefits, combined supporting is used: mainly the above 2 categories of supporting, e.g., the yieldable support and the bolting and shotcreting with beam, cable, net combined supporting. The supporting effect of this kind of combined supporting is not ideal, besides the working procedure is much, the expense is high (reaching about 10 000 Yuan/m), and the construction speed is slow, in the driving while repairs or rebuilding (maintaining is needed) frequently, the