Numerical simulation of the stability of deep roadway surrounding rock based on FLAC3D

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Abstract: In view of the problems such as roadway section deformation caused by the roadway's violent bottom drum, causing the roadway transportation and maintenance difficulties, the numerical simulation calculation software FLAC3D was used, and the numerical calculation was obtained, which was the vertical stress, horizontal stress distribution and plastic area distribution of the surrounding rock after the excavation of the roadway, and the analysis obtained the mechanism of the roadway bottom drum: because the weak top plate of the coal layer was disturbed by the weak top plate of the coal layer closer to the bottom of the roadway. Then the underside rock pressure of the roadway because of the bottom drum and continuous dynamic redistribution, and gradually to the right and deep development, and eventually lead to the bottom drum gradually deterioration and show left and right asymmetrical characteristics.

1. Introduction
The deformation of the deep roadway surrounding rock has the characteristics of large deformation, fastdeformation, continuous deformation of the roadway, the flow into the deformation of the deep roadway, and the characteristics of the expansion of the deep rock[1-3].

In view of the situation, domestic scholars carried out relevant research, Zhang Hechao, Fang Jian, Su, etc. by using FLAC3D to simulate the effect of roadway support under different support parameters, and studied the influence range of underground mining on surrounding rocks. Ning Jiangguo, Liu Quansheng, He Fulian[4-6], and so on use FLAC3D numerical simulation software to analyze the stress distribution characteristics of spatial intersection swaying and the stress increase and decrease zone formed along the axis of the laneway below. Niu Xuechao, Yan Changbin, Xiao Ming[7-9], etc. put forward the three-dimensional finite element numerical analysis method of dynamic simulation of the construction excavation process of large underground chambers, and analyzed the stability of the underground chamber group under the action of blasting vibration through engineering examples.

2. coal mine introduce
The designed length of +1650m transport roadway is about 2,200m, which is arranged in the rock roadway between C16 and C17 coal seams. The interval between layers of C16 and C17 coal is about 11.77m, the average thickness of C16 coal seam is about 1.83m, and the average thickness of C17 coal seam is about 1.09m. The roof is clayey siltstone and clastic limestone, and the floor is clayey siltstone and fine sandstone. Roadway section shape is straight wall semicircle arch, anchor bolt cable net support.

Current status of roadway maintenance: roof and two sides are maintained in good condition, with good rock integrity and basically no deformation; The floor heave is serious, especially near the left side, and part of the floor C17 coal seam is exposed. Joints and fissures of exposed C17 coal seam are
developed with poor integrity.

3. FLAC3D numerical calculation model
   According to the storage situation of the large block rock in the main transportation alley of 1650m, the numerical calculation model is established, the model size is 50m x 1m x 50m (length x width x height), the boundary condition is set to: the bottom surface is fixed, 4 sides limit horizontal direction motion, the top surface is the free boundary known for the load, and the pressure stress corresponding to the depth of the buried is 7.5MPa.

4. Analysis of numerical calculation results

4.1 Vertical stress
   The numerical calculation shows the contour situ chart of the vertical stress distribution of surrounding rock after excavation and the cloud chart of vertical stress distribution, respectively, as shown in Figure 1 and Figure 2 respectively.

4.2 Horizontal stress
   The numerical calculation shows the contour map of horizontal stress distribution of surrounding rock after excavation and the cloud chart of horizontal stress distribution, respectively, as shown in Figures 3 and 4 respectively.
It can be seen that, unlike vertical stress, affected by the roadway excavation disturbance, horizontal stress is concentrated at the top and bottom plate of the roadway, and the horizontal stress reduction area, horizontal stress elevation area and the original rock stress area are formed from shallow to deep in order, i.e. the evolution law of horizontal stress along the top and bottom plate vertical direction to the depth is increased and then reduced and then maintained at the original rock stress level, which is about 16.3MPa.

4.3 Distribution of plastic
The numerical calculation shows the distribution of the surrounding rock plastic area after excavation.
It can be seen from the figure that, under the influence of excavation disturbance, the surrounding rock in a certain range of the roadway enters into a plastic failure state. Compared with the roof and floor, the plastic failure range of the two sides is smaller, and the plastic failure range of the floor is the largest. The plastic area has developed to coal seam C17, while the plastic area of the roof is far from coal seam C16. The plastic area is the expansion range of the surrounding rock disturbance fracture, that is to say, in the current engineering under the geological conditions of Cheng, the cracks formed by roadway excavation will lead to the C17 coal seam and the roadway space, providing a channel for the C17 coal seam gas to flow into the roadway, but the C16 coal seam gas does not have this condition, and will not flow into the roadway in large quantities.

5. Conclusion
(1) Using numerical simulation calculation software FLAC3D, the numerical calculation obtains the contour map of vertical stress distribution of surrounding rock after excavation of the roadway of the main roadway of the horizontal stress distribution, the horizontal stress distribution contour map, the vertical stress distribution cloud map and the plastic region distribution.

(2) On the basis of the analysis of numerical simulation calculation results, the bottom drum mechanism of the concentrated transport lane of the 1650m was obtained according to the summary of the actual situation on the spot.

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