

Reasonable Position of Roadway in Upward Mining of Oil Shale

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ABSTRACT

The mining roadway stability is the directly major problem facing in the oil shale upward mining, in order to guarantee the stability of the roadway, we need to determine the reasonable position of the roadways. To this end, this article analysis the movement rule after mining the coal 2 and the deformation and failure state of oil shale 2 with field observations and numerical simulation analysis. Come to the conclusion that the moving boundary strata is about 15m, the impact angle is about 55 °, then, we determine the reasonable position of mining roadways.

KEYWORDS: Upward mining; Oil shale; UDEC; Fissure zone; Roadway position.

INTRODUCTION

The Coal and oil shale symbiosis in the BeiZao Coal Mine, the main minable seam of coal 2, Oil shale is a kind of accompanying economic, green and environmental material, the mining of coal 2 has ended, the exploitation belong to upward mining. In recent years, the strata movement rule and mining feasibility in upward mining, many scholars have carried out extensive research, many achievements were obtained^[1-4]. However in the aspect of reasonable location in upward mining, the research is less^[5-7]. To this end, this article uses the field measurement and numerical simulation to analysis the rational position of mining roadway, to ensure the stability of the roadway.

Mine strata belong to soft rock strata, but the oil shale is the dense hardened layer structure, great toughness, the average thickness is 5m. 1301 working face belongs to oil shale 2 is located above 2101 working face which belongs to coal 2. The distance between the two working face is about 21m. The length of 2101 working face is 150m, straight forward distance is 430m, average thickness of coal seam is 3.6m, bottom elevation is -355 ~ -371.4m.

DETECTION OF MINING OVERBURDEN ROCK FAILURE IN COAL 2

In order to obtain overburden rock failure condition after mining coal 2, and according to the results, we can research:

- The reasonable location of mining roadway. Set the observation roadway at the side of the stop mining line. Drill inclined drillings to overburden rock fracture zones above the gob, and detect the height of fracture zones with the double side water plugging device. Plan layout is shown in Figure 1.

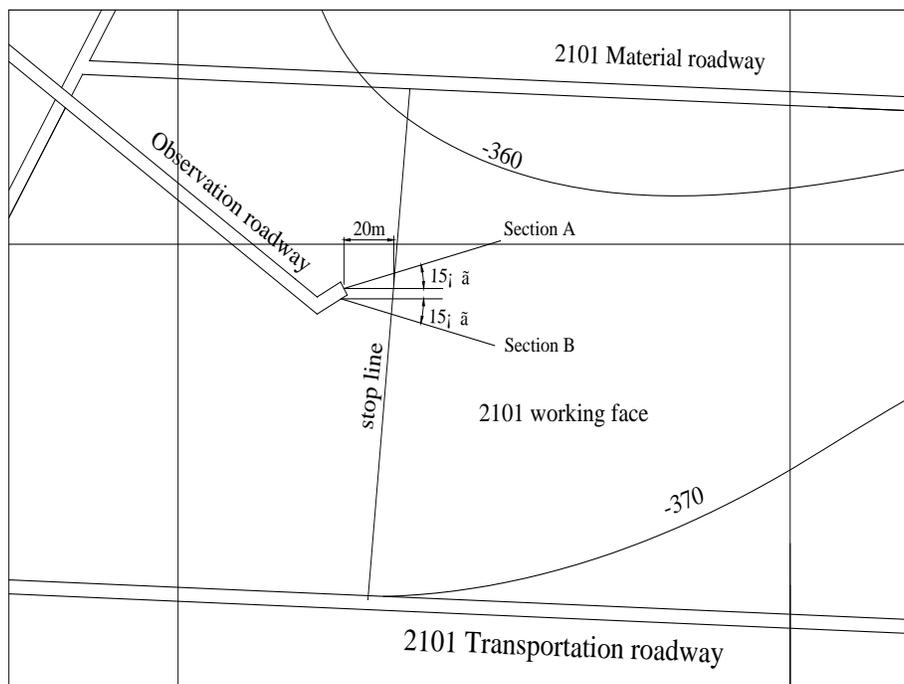


Figure 1: The plan of borehole layout

Set up two observation drilling nest in the flute of observation roadway, and set two observation sections. Section A is taken before drilling observation section, three borehole layout; section B is postharvest drilling observation section, five borehole layout, the drillings in section A is as the same as the drilling 1#,2# and 3# in section B, as shown in figure 2.

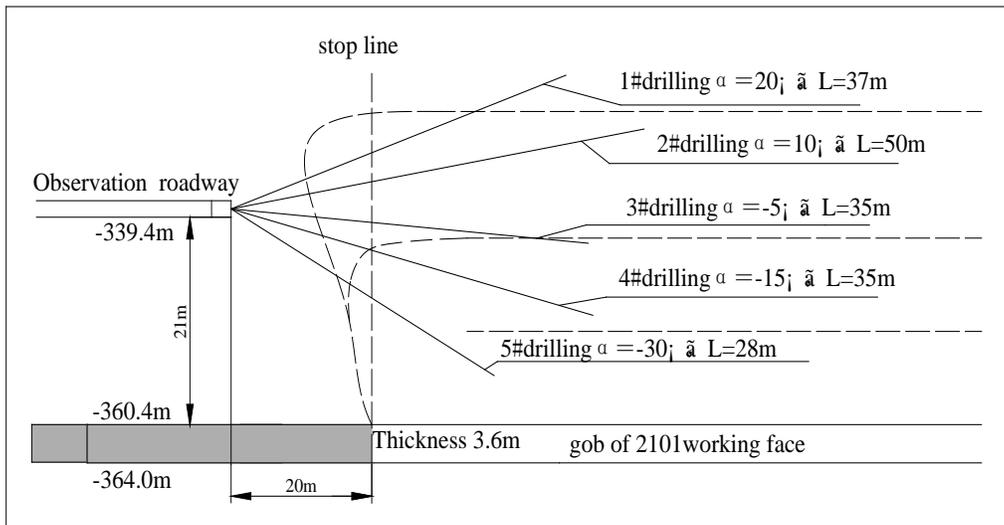


Figure 2: Profile of observation borehole

Drilling B2 observations is shown in Figure 3, by comparative analyzing, We can get the fissure zone height of drilling B2 is 27m. Comprehensive the all detection borehole observation results, in the 2101 working face ,the overburden rock fracture zone height is 28m, caving zone height is 11m, the fissure zone development pattern as shown in Figure 4.

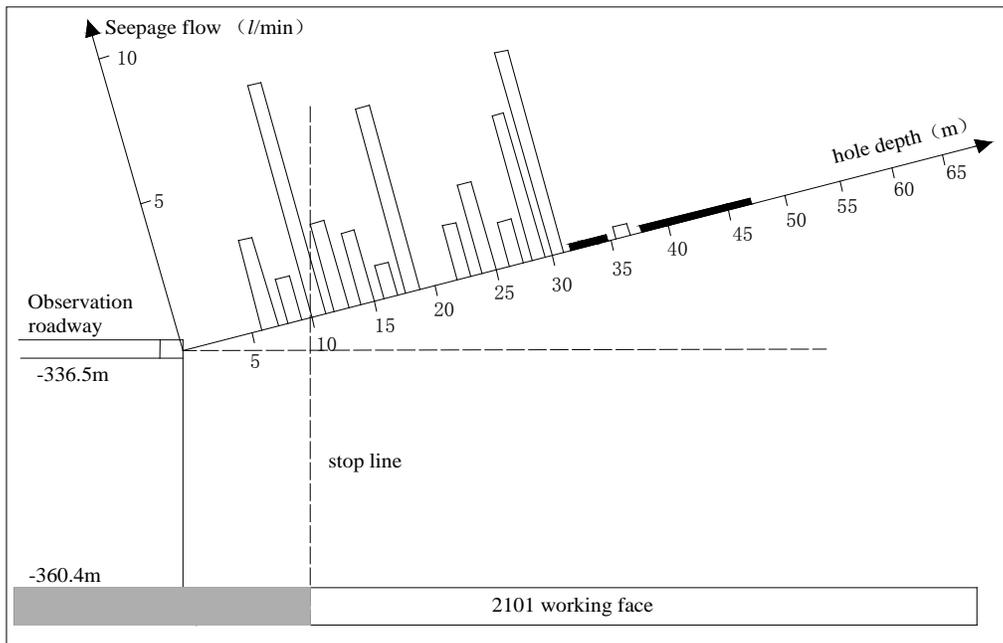


Figure 3: The observation results

In the caving border, the curvature of the bending deformation of overburden rock is the largest, therefore, the fracture height is the largest in the caving border; in the lateral of caving boundary, the bending deformation overlying rock is in a stretching state, easy to produce open

type fractures, therefore, fissure with lateral boundary is outward convex, outward width is about 15m, we can calculate influence boundary angle is 54.5° in mining coal 2.

By the observation results, oil shale 2 is in the outside of the caving zone in mining coal 2, and within fracture zones. In mined-out area boundary pillar outward within 15m, the oil shale 2 is affected seriously by mining coal 2, and the fracture is serious.

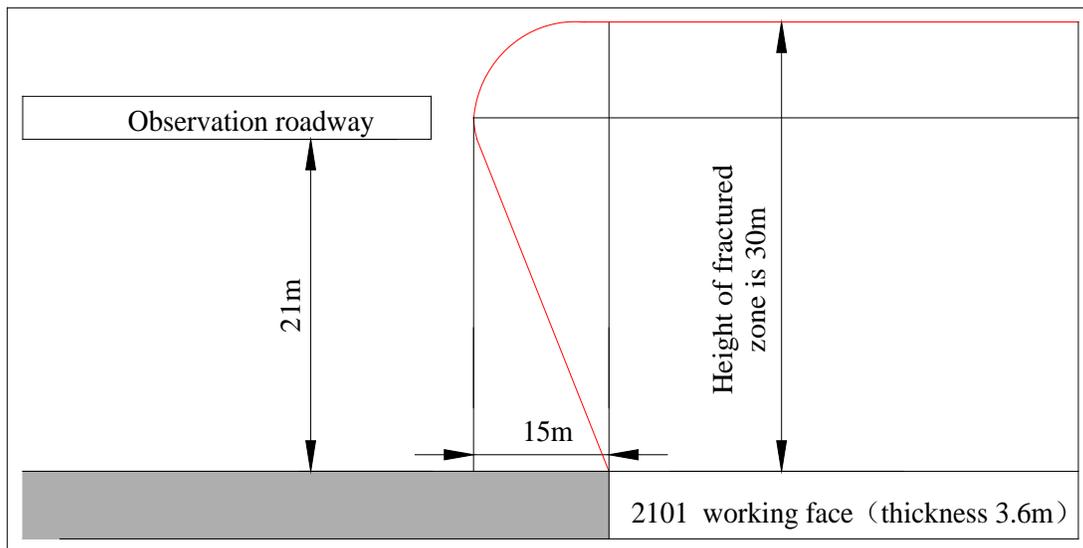


Figure 4: The form of fissure zone development

NUMERICAL SIMULATION ANALYSIS

Coal 2 is close to the floor of oil shale 2, there are large effects on integrity to oil shale 2 in mining, analyzed the deformation law with the UDEC numerical simulation software.

Numerical Simulation

Established the upward mining numerical model according to formation conditions, the model's horizontal length is 150m, vertical length is 105m, the thickness of oil shale 2 and coal 2 are respectively 5m and 3.6m. Model horizontal boundary on both sides and the lower boundary is fixed, evenly applied vertical stress 6.8MPa in the upper boundary, regarded as the upper 270m underground pressure, Adopting the elastic-plastic constitutive relations model of Mohr-Coulomb criterion to calculate, calculated parameters are shown in table 1 and table 2.

Table 1: Physical and mechanical parameters

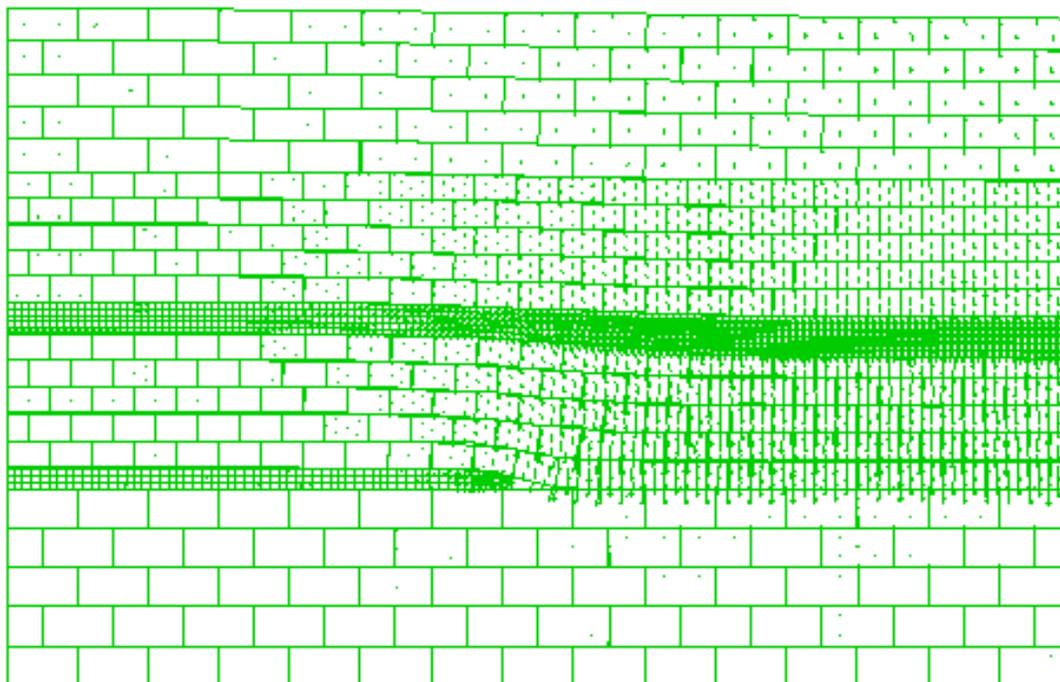
<i>Lithology</i>	<i>Thickness/m</i>	<i>G/GPa</i>	<i>K/GPa</i>	<i>$\rho/(kg.m^{-1})$</i>	<i>C/MPa</i>	<i>$\phi/(^\circ)$</i>
Marlstone	25	2.36	1.24	2360	2.2	32
Shale with oil	20.4	0.93	0.46	2200	1.5	28
Oil shale 2	5	1.53	0.76	2140	1.2	22
Shale with oil	21	0.93	0.46	2200	1.6	28
Coal 2	3.6	0.48	0.25	1350	0.8	18
Shale	30	1.86	0.92	2330	2.2	30

Table 2: Mechanical parameters of joints

<i>Lithology</i>	<i>kn/GPa</i>	<i>ks/GPa</i>	<i>C/MPa</i>	<i>t/MPa</i>	<i>φ/(°)</i>
Marlstone	2.5	1.8	0	0	16
Shale with oil	1.5	0.8	0	0	10
Oil shale 2	0.6	0.5	0	0	10
Shale with oil	1.8	1.0	0	0	10
Coal 2	1.6	0.8	0	0	8
Shale	2.5	1.8	0	0	16

Analysis of Simulation Result

In the model, oil shale 2 and its' adjacent rock displacement situation is shown in figure 5 after mining coal 2, the plastic zone distribution is shown in figure 6, combined with figure 5 and figure 6 ,the rock had obvious vertical displacement after mining, the largest displacement is about 3.6m, close to thickness of coal 2, the integrity of oil shale 2 is affected larger. The rock produced clearly plastic failure and tensile failure in the scope of mining influence, located in the center of gob, the floor of oil shale 2 is gentle sinking basin shape, continuity is better, located in the gob edge, under the influence of the border forms terraced sinking.

**Figure 5:** The diagram of rock displacement

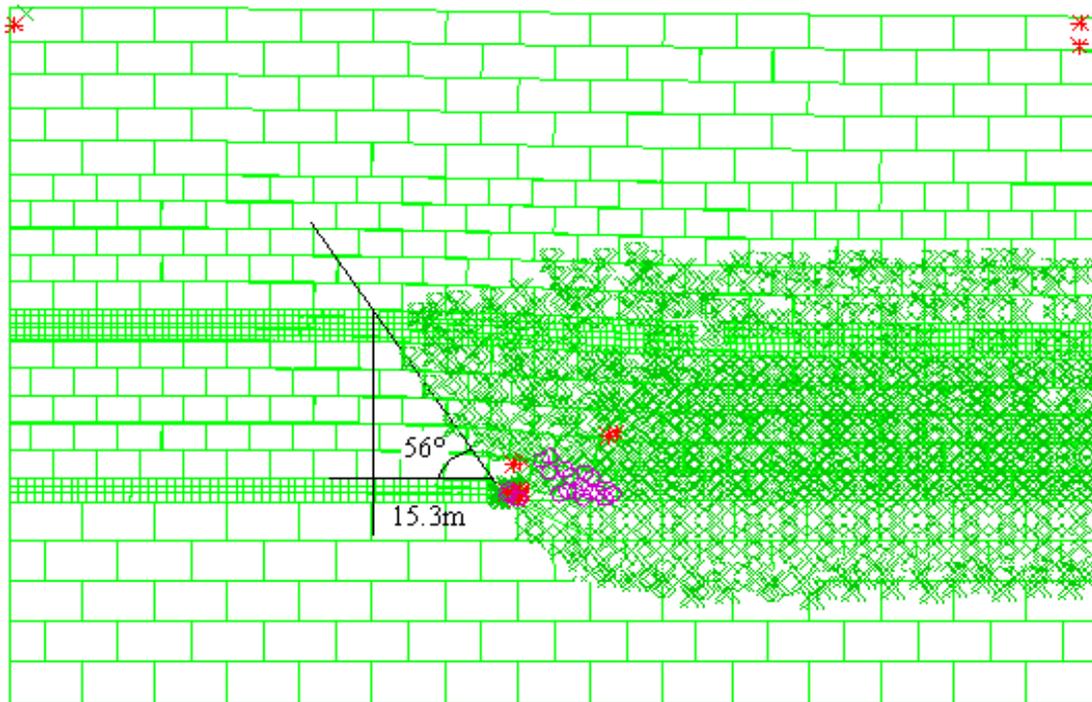


Figure 6: The layout of plastic zone

By the simulation results, mining boundary strata movement range is 15m, impact angle is about 56° , when the distance from oil shale 2 to coal 2 border less than half of the strata movement distance, rock strata movement is given priority to with stretch, when the distance is more than half from the border, the strata movement is given priority to with sliding motion.

THE REASONABLE POSITION OF MINING ROADWAY

Comprehensive fissure zone detection and numerical simulation analysis can be obtained that mining boundary strata movement range is about 15m on average, the average impact angle is 55° , distance of mined-out area boundary location are different, the oil shale 2 has different conditions of deformation and destruction. Therefore, mining roadway position is different, its stability will have bigger difference during oil shale mining.

When the distance between the roadway and boundary of mining coal 2 is less than or equal to 7.5m, that is half of the distance moved outside the boundary strata, the roadway is located in serious tensile deformation damage area, the stability of surrounding rock will be poor.

When the distance between the roadway and boundary of mining coal 2 is more than 7.5m, the roadway is located in rock sliding deformation zone, the stability of surrounding rock is relatively good.

When the distance between the roadway and boundary of mining coal 2 is more than 15m, the deformation of surrounding rock where the roadway located is smaller, the stability of surrounding rock is optimal, here is the best position for roadway layout.

CONCLUSIONS

The overburden rock fracture zone height is 28m, caving zone height is 11m in the 2101 working face, the oil shale 2 is in the outside of the caving zone, and within fracture zones.

Affected by mining coal 2, oil shale 2 produced larger deformation and failure, the maximum subsidence value is 3.6m, the position upper the gob is different, the oil shale 2 produced different deformation and failure state.

Comprehensive available, mining boundary strata movement range is about 15m on average, the average impact angle is 55° , the mining roadways should be arranged outside the scope of the moving range (15 m).

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