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Preliminary Study on Surface Movement Rule of Repeated Mining Working Face

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Abstract Based on analysis on surface movement of repeated mining working face of Baishan coal mine through GPS technology, this paper primarily analyzes the surface movement rule for repeated mining, therefore, it can efficiently provide guidance for the resettlement and reclamation of the mining area in the future.
Keywords GPS technology, repeated mining, surface movement

Intruduction

Coal mineral reserve is relatively less in Baishan coal mine. After mining on a large scale over 30 years, resources have almost been exhausted. Repeated mining will be a try for recovering coal resources and extend the service life of wells. Surface movement parameters obtained from observation stations established before are all the observation results under primary recovery, which are not suitable for surface movement caused by repeated working faces,Thus, observation stations should be built on the repeated working faces, by means of observation to get parameters for surface movement and transformation to provide guidance for the resettlement and reclamation of the mining area in the future.

FC635 working face (refer to the fig. 1 below) with a corresponding surface elevation of +29 m.Strike length of the face is about 324 m, tilt width ranges from 60 to 128 m. The working face is divided into repeated mining and residual mining parts. Of which average thickness of the remaining coal is 1.0m with a recoverable area of 22641 m^2, the average thickness of coal in the residual mining area is 2.6 m with a recoverable area of 4,009 m^2. Total geological reserves of the two parts are 49,000 t. The occurrence trend of coal seam is featured in high airway and low machinery tunnel. Elevation of coal seam ranges from -185.1 m to-224.8 m and dip angle of coal seam ranges 5° - 25°。

Method selection

FC635 working face is the first repeated mining working face in both WanBei Coal& Electricity Co., Ltd. and Baishan Coal Mine. Farmland, buildings and fish-pond are collapsed again due to the recovering, so, how to measure the surface movement?

In the observation research of movement and transformation, traditionally, elevation is measured by means of level gauge regularly, while coordinates of points are positioned by means of total station, but it has a low efficiency and big workload, besides there are some limitations (Di et al. 1992).However, the GPS technology characterized by quick observation, high automation, no need of intervisibility between observation stations, all-weather observation, simultaneous determination of coordinate and elevation of the observing points (Gao. 2014), so, new type of GPS is applied to measure the surface transformation rules in this observation. Basic contents of the work are to measure the variations in the mining process of the working measurement points regularly and repeatedly, mainly the surface subsidence. GPS direct surface positioning and observation station are applied to gather the original data. South Lingrui S86 RTK is used in the field, namely, new GPS technology is used to collect data from the observation points (coordination and elevation), while interior work is done by output of computer, then the observation data is computed and collected accordingly.

Survey line arrangement

This observation station (as shown partially below) is the first surface movement observation station in Baishan mine. Strike observation line goes across the fish-pond and then goes along the road extending in the south-east direction, tendency observation line is set as a semi-basin observation line down the hill, control point of the observation line is 190 m away from cut and working face; straight length of the strike observation line is 680 m, while that of tendency observation line is 400 m. Total number of observation points is 50.

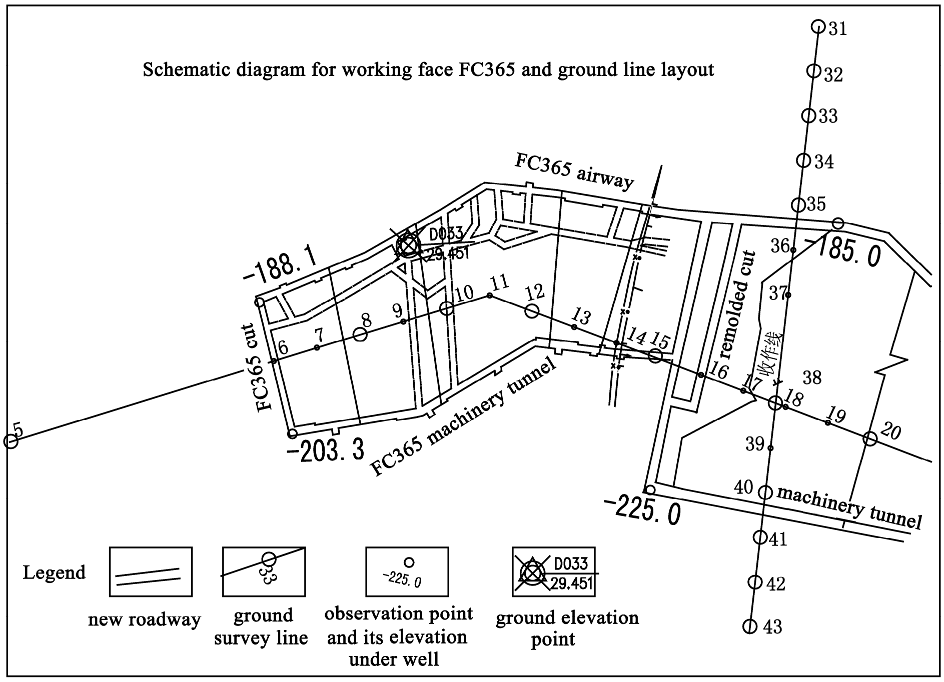

Fig. 1 Layout of meascurment lines above Panel FC636

Data analysis

FC635 working face is anomalous, with an advance rate of 1.8-3.6 m/d, observation twice a week during the recovery period, once every two days after the surface movement going into active period. Observation results are as shown below:

① When recovering at 28m on the working face, surface starts moving and transforming.

② During the recovering of the working face, the maximum sinking value of the main section is 0.97 m during the recovering period, while the maximum sinking value in the tendency direction is 0.17 m. (Refer to the table below and the corresponding curves)

Table 1 Total sinking value

Observation point in the tendency direction	31	32	33	34	35	38	40	41	42	43
Total sinking value(mm)	56	65	68	-112	-173	-154	-151	-107	-78	-76

③ When recovering at 42 m of the working face, fractures of the house walls are as seen at 55 m away in the north-west direction of the cut. Width of fracture doesn't increase again when the recovering reaches at 85 m.

Rules and characteristics of surface movement and transformation

Rules and characteristics of rock movement are as shown below according to the measured data.

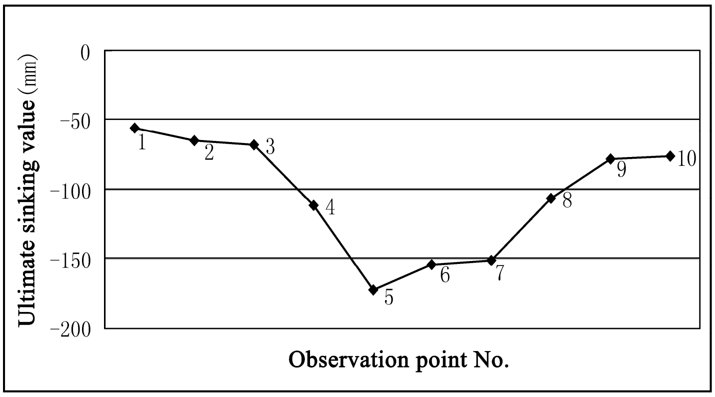

Fig.2 *Sinking curve in the tendency direction*

Table 2 *Total singking value strike observation*

Strike observation point	5	8	10	12	15	20
Total sinking value(mm)	1	-766	-975	-812	-349	-4

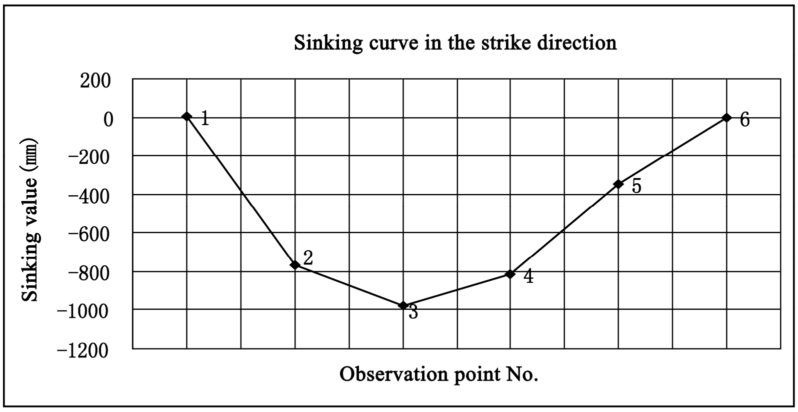

Fig. 3 *Sinking curve in the strinke direct*

① Relations between sinking movement rate of surface and mining depth, mining height of the working face.

Direct ratio is seen in the relation between transformation and sinking rate and mining height of surface movement, while inverse ratio is shown to that of mining depth. Average mining depth of repeated mining FC 635 working face is over 228 m, the average mining height is 1.6 m, and the ratio between mining depth and mining height is high. In addition, there has already been a mining damage to the roof of the working face, so, the surface has a low sinking rate and a short duration, with the maximum sinking rate of 24 mm/d.

② Influence factors under the surface movement on the working face.

Rock body of the upper strata is damaged after the first recovery. The movement between surface and rock body has suffered forms such as inbreak, bending, sinking and sliding along the strata. The whole roof is damaged and the coal seam in the residual mining is thin. Since it has been over 30 years since the first recovering, the "Three Zones" of the strata have sufficiently developed. The delamination fracture formed in the strata's sinking process is smaller than that in the first recovering, resulting that the maximum sinking value of the surface on the working face is lower than the value of mining height, the sinking ratio q=0.57.

③ Movement of the surface after two months of the recovering on the working face tended to be stable, with the maximum advance influencing distance around 80m.

Conclusions

The application of GPS technology in the building of observation station has advantages such as fast, efficient and flexible over the traditional total station and level gauge, because it's unnecessary to bury foundation piles under the ground and farmland suffer less damage, therefore, building cost is greatly reduced. In addition, there is no contradiction between farmland and mining caused by burying foundation piles and damaging young crops, thus, cost of 300,000 yuan will be reduced in construction of the observation station and observation fees.

In addition, relatively few tendency observing lines are set. working faces of repeated mining are irregular, and observation is stopped ahead of schedule because the coal seam is thin, which may result in a certain error on the conclusions for surface influence caused in repeated mining, it is required to be further studied.

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