Study on Flatten Slope Design of Coal Mine Slope

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Abstract

Due to the loess slope caused by excavation, in the vicinity of the industrial square and the edge of the road, the slope is steep, the height is large, the unloading cracks are developed, and there are hidden troubles of collapse and slide. Based on the engineering geological survey, field survey and indoor soil test research of Anshan coal mine slope in Liaoning. Slope 13 and slope 15 are selected. Morgenstern-Price method is used to calculate the slope stability under different cutting slopes. Through different combination of cutting slope， the stability coefficient of four kinds of natural conditions, rainfall, earthquake, earthquake and rainfall are calculated by GEO-SLOPE software. By comparison, the optimal slope cutting scheme is obtained. Research shows that: The position change of the large platform will affect the stability of the slope. When two platforms are set up, the stability of the slope is significantly improved, and the stability is best when the two platforms are located in the middle of the slope. When the width of the platform is the same, the slope ratio has a great influence on the slope stability. The change of the slope type also has a great influence on the slope stability. Considering the engineering budget, cut slope engineering quantity and slope stability, project 14 is recommended to treat slope 13, and project 11 is recommended to treat slope 15.

Keywords

Coal mine slope, flatten slope, stability analysis, conceptual design, GEO-SLOPE.

1. Introduction

Based on the geological survey report of Anshan coal mine slope in Liaoning Province, this paper analyzes the engineering geological conditions of slope, and on the basis of stability calculation, studies the design of slope cutting program and analyzes the stability by using GEO-SLOPE software to calculate the difference Under different conditions of the stability of the program, and select the best cutting program [1-5].

2. Engineering Geological Conditions

Liaoning Anshan Coal Industry Co., Ltd. Industrial Square, the main shaft around the production area more than the elevation of 1312.5 ~ 1513.4m. Complex terrain in the area, rolling hills, vertical and horizontal valleys. Broken terrain, mostly narrow beam, the general length of hundreds of meters to several kilometers long, tens of meters wide to hundreds of meters, collapse and landslides more developed.

Due to the ups and downs of the site and the large elevation difference, a comprehensive evaluation is made according to the strata and sedimentary features exposed by the drilling. Combined with the comprehensive analysis of regional geological data, the foundation soil in the site of survey depth is mainly composed of miscellaneous fill, plain fill, silt, pebble soil and silty clay.

According to the preliminary survey report, the depth of partial well-determined water level measured in the survey depth ranged from 3.00 to 10.50m. The type of water is submerged.

The groundwater depth of the site under investigation is mainly affected by the lateral runoff and precipitation, and the water level changes with the seasonality. During the survey period is a flat water period, annual variation range of groundwater level is about 1.0m. Of the 74 boreholes and exploration wells in the Anshan Coal Industry Co., Ltd. industrial plaza slope survey, only 18, 24, 33 and 47 boreholes revealed groundwater.

3. Stability Analysis and Design of Cutting Slope

The current methods for calculating slope stability are the limit equilibrium method and the finite element method [6-12]. The limit equilibrium method is the stability coefficient of the whole slope, the analysis of the assumption that the block is rigid, cannot consider the slope deformation, and the method does not take into account the deformation and displacement of the coordination, resulting in the method cannot consider the local area The calculated stress can not represent the real situation. The finite element method can reflect the deformation and stress state of the slope more realistically, but it is not yet mature in slope stability analysis. We study the Anshan Coal Industry Co., Ltd. Industrial Square, the main shaft surrounding the stability of the production area using the method of limit equilibrium method to consider the stability.

There are many methods of limit equilibrium method. In this paper, Morgenstern-Price method is adopted. The method not only considers the balance of force, but also considers the moment balance. It is suitable for any sliding surface and also for circular sliding surface. The calculation parameters are shown in table 1.

Table 1 Selection of calculation parameters

layer	natural			saturation		
	γ	c	φ	γ	c	φ
Silt	16.7	32	25.5	19.1	22.3	21.6
Silty clay	18.7	45	30	19.9	24.8	17.2

According to the distribution of the buildings and mining areas of Anshan Coal Industry and the surrounding topography, two slopes of 13 and 15 were taken along the slope of the study area.

The thickness of the formation to be analyzed and its dip angle are determined based on the profiles drawn from the borehole and exploration data and the field description.

According to the above mentioned slope stability calculation of the type of working conditions, the Anshan Coal Mining Company 13, 15 were considered on both sides of the slope of four cases were four cases, (1) the slope in a natural state; (2) consider the role of rainfall; (3) consider the effect of earthquake; (4) consider simultaneous effects of rainfall and earthquake.

Table 2 shows the stability coefficients of section 13 and section 15 calculated under the four conditions with different methods of slope reduction.

As can be seen from the data in Table 2, the stability factor of section 13 in the natural state is 0.858, and slips may occur at any time. In addition, there is a factory building at the foot of the slope and a flow of people, so there is greater safety Hidden trouble. Section 15 is 1.096, stability coefficient is greater than 1, slope stability is good, but in order to ensure the safe production of coal mines, still need treatment.

In addition, there is regularity in the calculation of stability of slope cutting schemes under different working conditions in the same section. The effects of rainfall and earthquake are different due to the difference of slope shape and topography. At the same time, considering the effects of earthquakes and rainfall, the stability of the slope is the worst, which is consistent with the actual situation.

Table 2 Different slope stability program stability coefficient

Program	13 profile				15 profile			
	natural	rainfall	earthquake	rainfall and earthquake	natural	rainfall	earthquake	rainfall and earthquake
Original	0.858	0.848	0.825	0.782	1.096	1.007	1.056	0.737
1	1.243	1.209	1.207	1.161	1.507	1.392	1.418	1.329
2	1.287	1.241	1.233	1.191	1.506	1.433	1.446	1.366
3	1.335	1.286	1.277	1.222	1.572	1.458	1.519	1.410
4	1.378	1.327	1.316	1.254	1.537	1.441	1.481	1.376
5	1.413	1.330	1.354	1.276	1.425	1.340	1.364	1.289
6	1.366	1.293	1.257	1.243	1.499	1.428	1.453	1.372
7	1.290	1.251	1.228	1.206	1.470	1.330	1.414	1.331
8	1.172	1.155	1.126	1.090	1.476	1.404	1.410	1.331
9	1.195	1.159	1.144	1.111	1.256	1.209	1.201	1.159
10	1.245	1.202	1.189	1.175	1.339	1.273	1.289	1.224
11	1.271	1.221	1.201	1.168	1.342	1.277	1.282	1.223
12	1.248	1.211	1.190	1.158	1.319	1.245	1.261	1.197
13	1.054	1.016	1.009	0.985	1.209	1.114	1.159	1.082
14	1.121	1.066	1.065	1.028	1.280	1.207	1.224	1.162
15	1.099	1.068	1.069	1.016	1.264	1.185	1.210	1.143
16	1.099	1.067	1.071	1.026	1.240	1.146	1.181	1.109

For slope 13, from the data in Table 2, it can be seen that after slope cutting, the stability coefficients of slope under different working conditions are all improved. Through the comparison of schemes one to sixteen, it can be seen that the change of the position of the wide platform will affect the stability of the slope. When the single-stage slope is 1: 1 and the single-stage slope is 8 meters high, the fifth scheme is the optimal scheme. When the single-stage slope is 1: 1 and the single-stage slope is 10m high, the eleventh scheme is the optimal scheme. When the slope of grade is 1: 0.75 and the height of single slope is 8 meters, the optimal scheme is scheme fourteen; the slope gradient of single stage is 1: 0.75; when single-stage slope is 10 meters high, nineteenth is the optimal scheme. Comparison of the above programs, program five and program eleven, after the slope stability is good, but difficult to cut slopes, large amount of cutting slope; program fourteen and program sixteen, the stability after cutting slope than the first two The scheme is poor, but it is less difficult to cut the slope, and the construction amount of the slope cutting is smaller, so the cost is superior to the scheme five and scheme eleven. When setting two large platforms, compared with the previous program, the stability is better, but the project is large, under conditions permitting, it is not recommended. Analysis of the above slope type, combined with the project budget, the amount of slope cutting and slope stability considerations, the program fourteen for the optimal program.

For the slope 15, from the data in Table 2, it can be seen that after the slope cutting, the stability coefficient of the slope under different conditions of section 15 has been increased. Observing the entire table shows that after slope cutting, the slope stability coefficient has been improved. When the single-stage slope is 1: 1 and the single-stage slope is 8 meters high, the third scheme is the optimal scheme. When the single-stage slope is 1: 1 and single-stage slope is 10m high, the sixth scheme is the optimal scheme. Slope ratio of 1: 0.75, single-stage slope height of 8 meters, the eleventh program for the optimal program; single-stage slope of 1: 0.75, single-stage slope of 10 meters, fourteen for the optimal program. Compared with the above schemes, scheme 3 and scheme 6, the stability after the slope cut is good, but it is difficult to cut the slope and the project for cutting the slope is large. In the eleventh and the fourteenth scenarios, the stability after the slope cutting is higher than the former two schemes Poor, but less difficult to cut slopes, smaller amount of cutting slope, the cost is superior to the program three and six. When setting two large platforms, compared with the previous program, the stability is better, but the project is large, under conditions permitting, it is not recommended. Analysis of the above slope type, combined with the project budget, slope reduction and slope stability considerations, program eleven for the optimal program.

4. Conclusion

Because the shape of slope determines the state of soil stress inside the slope, in order to adapt the slope shape to the structural features of the soil, and the stress state is better, it is necessary to ensure the stability of the slope and save the project volume, so choose The right slope is especially important. In this paper, different slopes are designed and simulated by GEO-SLOPE software to determine the optimal slope cutting plan and put forward suggestions for slope treatment to create a safe working environment for local factories and mines. According to the analysis of the above two sections, the main conclusions are:

(1)The location of large platforms will affect the stability of the slope.

(2) When two large platforms are set, the stability of the slope is significantly improved, and the stability is best when the two large platforms are located in the middle of the slope.

(3) When the platform width is set the same, the slope ratio has a greater influence on slope stability than the slope height. The change of slope type also has great influence on slope stability.

(4) Combined with the project budget, the amount of slope cut and the slope stability considerations, Slope 13 proposed to use program fourteen governance; Slope 15 proposed the use of program eleven governance. If you follow the “checklist” your paper will conform to the requirements of the publisher and facilitate a problem-free publication process.

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