Appropriate Design for the Open Pit Slope with Loess Layer in Angren Brown Coal Mine in Uzbekistan

Sunnat ISLAMOV

Laboratory of Rock Engineering and Mining Machinery

Department of Cooperative Program for Resources Engineering

1. Introduction

Angren coal mine is the largest coal mine in Uzbekistan and produces about 4.5 million tons of brown coal annually by open pit mining. The failure of open pit slope often occurs due to the weak geological condition and it is a serious problem in this mine. From this reason, it is necessary to develop a design guidelines and control measures for maintaining the stability of the open pit slope. This study describes the causes of the slope failure and discusses the appropriate design of the open pit slope in this mine by means of finite element analysis code 'Phase^2 ver.5.0'.

2. Numerical analysis

A numerical model is constructed based on the geological in this mine as shown in Fig.1. Elasto-plastic analysis is conducted. Table 1 shows the mechanical properties used in this research. A series of numerical analysis is conducted to discuss the design guideline for the open pit slope in different geological conditions. The critical strength reduction factor (SRF) is used for the evaluation of slope stability. According to the risk rating on slope stability, the safety level of the slope has considered being the critical value when the critical SRF is 1.3.

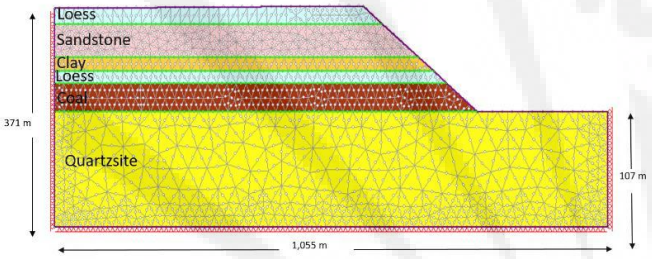

Fig1. Finite element model

Table 1. Mechanical properties used in this analysis

Rock	Young's Modulus (E) MPa	Poisson's Ratio (v) -	Cohesion (c) MPa	Friction Angle (ϕ) °	Unit Weight (MN/m^3)
Loess	350	0.33	0.34	26	0.027
Sandstone	6.399	0.3	4	33	0.027
Clay	30,000	0.35	0.36	32	0.027
Loess	350	0.3	0.34	26	0.027
Coal	4,000	0.3	0.8	30	0.014
Quartzsite	29,000	0.32	11	38	0.028

3. Results and discussions

Figs. 2 and 3 show the results of numerical analysis. Fig.2 shows the distribution of the shear strain and the critical SRF in different overall slope angles. Fig.3 shows the relationship between the overall slope angle and the critical SRF in the current working pit. It can be seen clearly from Fig.3 that the critical SRF of the open pit slope increases with decreasing the overall slope angle. From the geotechnical and operational cost points of views, the overall slope angle of current working bench should be around 40 degree in the current geological condition. However, as the loess layer has an obvious impact on the stability of the slope and the stability of slope decreases with increasing the thickness of loess layer, the overall slope angle should be changed depend on the condition of loess layer.

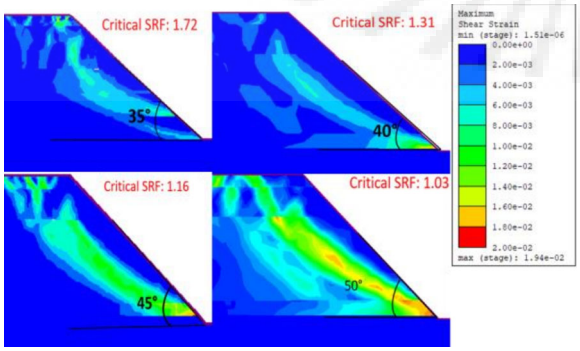

Fig.2. Distribution of shear strain and the critical SRF in different slope angles.

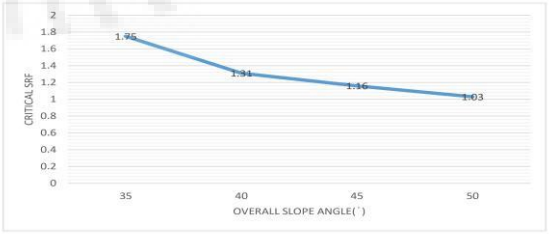

Fig.3 Relationship between the overall slope angle and the critical SRF in the current working pit.