Study on Buffer Zone Optimization between Open Pit and Dumping in Erdenet Mine in Mongolia

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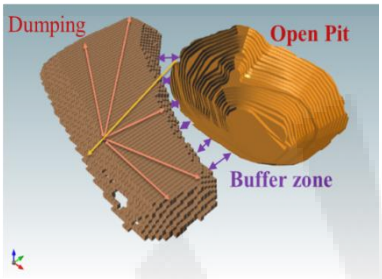

Fig.1 Schematic diagram of the buffer zone.

1. Introduction

Creating waste dump near to the pit is one of the solutions when the waste rock contains low grade of valuable minerals that planned to be extracted in future. Waste dump alongside the pit also gives an advantage to waste hauling cost. However, creating a waste dump alongside the pit should be planned well thus it does not give worse affect to pit slope stability. The shear strain acts on slope surface must be controlled thus it does not over the shear strength of the pit slope by spacing pit slope and waste dump boundary. This spacing is called buffer zone (Fig.1). A buffer zone on the configuration can reduce gravity load acts on the pit slope, accordingly the shear strain along the slope surface stable under the shear strength of the pit slope. This research discusses about optimization design of buffer zone design.

2. Research Methodology

The optimization design of buffer zone must be chosen to fit the configuration of pit as well as the waste dump. Therefore, in this research, the study is carried out by considering the current configurations of pit slope as well as waste dump, and the long term mine planning of the mine depth and amount of the waste dump material. The optimization of the buffer zone geometry is carried out by investigating and comparing the performance of geometrical combinations between buffer zone length, pit slope height and dump bench height (Fig.2). The study was done by FEM Phase2 software, in which adopts shear strength reduction factor method (*CSRF*) as failure criteria. According to risk rating on slope stability, the safety level of the slope is considered to be the critical value when the *CSRF* is 1.2.

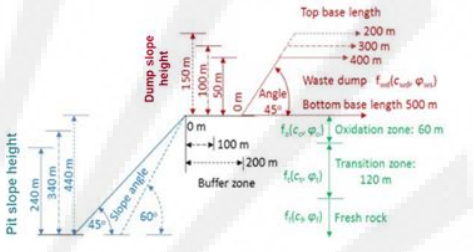

Fig.2 Configuration of numerical calculation.

3. Results and Discussions

According to simulation results that shown in Figs.3a and 3b, the *CSRF* is significantly reduced from 1.46 (safe) to 1.22 (critical value) when a 50-m-high × 500-m-long waste dump is created alongside a 340 m-high pit slope. Figs.3a and 3b show that the circular limit-shape yield zone on slope surface increases in creating the waste dump, accordingly the potential sliding surface increases, due to increase in shear strain at the toe of the pit slope. Furthermore, the shear strain will worst in increasing the mine depth, in which the pit slope height increases, due to increase in self-load of the slope surface. This situation is followed by decrease in *CSRF* (Table 1). A buffer zone is necessary to be created when the *CSRF* is around 1.2 to improve stability of the pit slope surface. Fig.3c proves that buffer zone can reduce the shear strain in the toe of the pit slope and the yield zone along the slope. The waste dump will not give any significant influence on stability of pit slope surface when the buffer zone length is more than 200 m for waste dump height less than 50 m (Fig.3c). Moreover, an attention must be given when the waste dump height is over than 100 m for any buffer zone lengths due to increase in shear strain at toe of waste dump slope (Fig.3d), which may initiate waste dump slope surface failure.

It is clear that buffer zone can improve the pit slope stability when it is designed to fit the configuration of pit as well as the waste dump thus the shear strain does not over the strain strength.

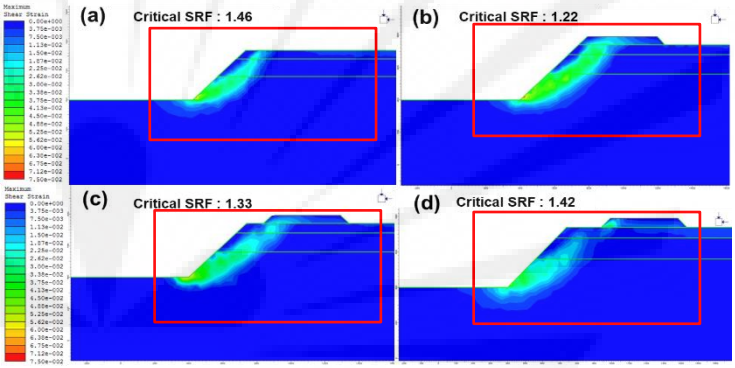

Fig.3 Result of slope stability simulation for 340 m pit wall height: (a) Without dump; (b) 50 m-high dump without buffer zone; (c) 50 m-high dump with 200 m buffer zone length; (d) 100 m-high dump with 100 m buffer zone length.

Table 1. Result of slope stability simulation for pit wall and dump under different length of buffer zones (*H* is pit slope height; *h* is waste dump height).

No.	*H*, m	*h*, m	*CSRF* for simulation under different length of buffer zone				
			0 m	50 m	100 m	150 m	200 m
1	240	50	1.33	1.49	1.56	1.56	1.62
2		100	**1.14**	1.31	1.41	1.48	1.54
3		150	**1.06**	**1.19**	1.34	1.35	1.36
4	340	50	**1.22**	**1.28**	1.33	1.36	1.42
5		100	**1.12**	**1.2**	**1.27**	**1.28**	1.3
6		150	**0.94**	**1.04**	**1.19**	**1.15**	**1.2**
7	440	50	**1.15**	**1.21**	**1.26**	**1.29**	1.32
8		100	**1.07**	**1.13**	**1.16**	**1.19**	**1.22**
9		150	**0.87**	**0.9**	**1.12**	**1.15**	**1.19**