Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 12 (2011) 248–253

Engineering Procedia

2011 SREE Conference on Engineering Modelling and Simulation

Research on slope stability analysis of super-high dumping site based on cellular automaton

Guangjin Wang[a,c]*, Xiangyun Kong[b], Yilei Gu[c], Chunhe Yang[c]

[a] *Faculty of Land Resource Engineeirng,Kunming University of Science and Technology, KunMing 650093, China*
[b] *No. 268 Brigade of Jiangxi Nuclear Industry Geological Bureau, Yushan,Jiangxi 334701, China*
[c] *College of Resources and Environmental Science,Chongqing University, Chongqing 400044, China*

Abstract

Apparent particle size grading is the most important characteristic of super-high dumping site. On the basis of the development of the HHC-CA model and on-site survey of granular size distribution, the slope model of current situation, had considered the features of particle size grading, was established according to a super-high dumping site. FLAC^{3D} was used to analyze the slope stability of current situation and various piling up patterns slope based on the slope model. The results indicated that the upper displacement vector, whose displacement direction maintained the same direction of the current situation slope of a super-high dumping site, performanced for subsidence. The middle displacement vector showed shear and the displacement vector of bottom had slightly the trend of anti-lift. The slope failure model of current situation expressed in crack at the top platform and shearing out with a arc in the middle. This status of current situation slope was temporary steady stage. To adopt full overlay dump of multi-step, the displacement vector of dumping site slope showed subsidence at the top and transited to the horizontal direction at the bottom. The slope failure mode expressed in crack at the top platform and shearing out with a arc at the bottom. When considering the influence of strength characteristics of granular pile on the slope stability only, the particle size grading of super-high dumping site was helpful to slope stability.

Keywords: super-high dumping site；granular particle size grading；Cellular Automaton；FLAC^{3D}；slope stability analysis

1. Introduction

Dumping site was the artificial slope which had been piled up by the mining waste granular. So it had its own characteristics. The major distinction was that the super-high dumping site adopting the whole section height dump of single-step had apparent particle size grading.The overall law represented [1], the size of particles increased gradually with the increment of the high of dumping site, the overall trend was

1877–7058 © 2011 Published by Elsevier Ltd.
doi:10.1016/j.proeng.2011.05.039

that small block concentrated in the upper part, large block was in the lower, the middle part was middle block mostly. However, engineers greatly simplified the important characteristic of dumping site in the analysis of slope stability, most of them divided the accumulational granular into the upper, middle and lower, and some engineers even took it into the same size to do slope stability analysis[2-5]. As we all knew, the strength parameters of accumulational granular was a critical factor to compute slope stability analysis, and the composition of different particle size was the main influences on the strength parameters.Therefore, such over-simplified was unscientific and unreasonable to the computing result of slope stability analysis. This article would use the cellular automata to generate automatically the required percentages, and calculating the slope stability needed only to enter percentages of each size group and the corresponding mechanical parameters of granular material of the super-high dumping site's each layers, while each layers did not set different mechanical parameters. This not only could save a lot of manpower, financial resources and time, but also improve the reliability of slope calculation.

2. Measuring the granular size of a super-high dumping site

Depending on the Combination of screening and direct measurements method, this article did the on-site investigation to the particle size distribution of the granular materials of super-high dumping site. according to the classification of particle size[6]: PG-G, SB-G and LB-G. The article used the blasted pile granular to indicate the unsized granular of dumping site and chose three non-fractionated granular materials to do the size survey in the top platform of dumping site, the results were in Table 1. Meanwhile, in order to obtain the particle size distribution with the change of dumping site height, the writer set a representative survey line in the middle position of dumping site and deployed a test point at 10m intervals in the survey line (a total of 12 test points), the results was shown in scheme Ⅰ of Table 2.

Table 1 Granular classification and blasting accumulate granular fragmentation results

Granular names	symbols of classification	Range of particle size (mm)	The contents of each particle size of blasting granular (%)			
			Ⅰ group	Ⅱ group	Ⅲ group	Average value
powdery-granular granular	PG-G	d<10	27.3	20.2	25.3	24.3
small-block granular	SB-G	10<d<60	47.9	50.8	45.5	48.0
large-block granular	LB-G	d>60	24.8	29.0	29.2	27.7

3. HHC-CA model and the slope model

Based on the Cellular Automata, this paper generated randomly three different contents material by aid of the developed HHC-CA model, which indicated respectively PG-G 、SB-G and LB-G.

the evolution rules were as follows：

1) The cellular will keep their previous state unchanged When the cellular state is not zero.

2) When the cellular state was zero，the total neighbor cellular numbers with similar state will be calculated. Num_1 is representative of the total number of neighbor cellular whose state is 1， Num_2 is representative of the total number of neighbor cellular whose state is 2. Generally speaking，one of the Num_1 and Num_2 is aways zero， which shows only a status existed in the cellular neighborhood. It is only when the two cellulars are quite close in the evolution that the Num_1 and Num_2 can not be equal to zero at the same time.

3) To compare Num_1 with Num_2，the central center has the evolution trend to the cellular of big number，its probability of evolution is Max (Num_1, Num_2) × 0.125.