International Journal of Security and Its Applications
Vol. 10, No. 3 (2016), pp.283-294
http://dx.doi.org/10.14257/ijsia.2016.10.3.25

Slope Stability Analysis of Open Pit Mine Based on AHP and Entropy Weight Method

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Abstract

There are several factors influencing the slope stability of open pit mine, and the common methods can be divided into the subjective weighting method and the objective weighting method. In this paper, we make comprehensive evaluation of slope stability by using AHP method and entropy weight method. First of all, we make evaluation of the first level indicators, using AHP method to determine the weight of factors and then use the entropy weight method to calculate the influence factors, the conclusion has certain reliability and scientific nature. Through field monitoring, we get the membership function of each influence index by using assignment method and trapezoid distribution. Following the principle of maximum membership, slope II is the most stable, followed by slope V and slope I, slope III and slope IV are poor stability. This result is consistent with the on-site inspection, and then we proposed treatment measures according to the engineering practice.

***Keywords**: Open pit mines, AHP method, slope stability, security analysis, entropy weight method*

1. Introduction

The slope of open pit is the same as the earthquake and volcano, and it becomes the three major geological disasters. With the rapid development of China's economy, a growing number of open pit mine artificial slope and China is located the world's two largest earthquake zone, the earthquake disaster prone, the situation is even more severe. Mine slope stability or not, the safety, feasibility and economic of the project have important control function, and affect the project construction investment and benefit, economic damage and personnel casualty. Therefore, the management of mine slope is an important content of open pit mine, and the management of the slope is directly related to the safety of the open pit. Evaluation of slope stability of open pit mine is a complex and comprehensive problem. Slope failure will give people's lives and property security and the country's economic construction will bring immeasurable loss, so how to effectively evaluate the stability of the slope stability is of great practical significance. [1] due to open pit slope is a dynamic open system, the mechanical parameters of rock slope, surface distribution structure rules are extremely complicated, many factors affect the slope stability, and the relationship between factors and factors of the complex is often nonlinear, it is difficult to use explicit mathematical methods or mechanical methods are described and solved accurately at present, most scholars through some new disciplines and theory and cross[2-3], and gradually formed a new method for slope stability analysis,

ISSN: 1738-9976 IJSIA

this paper proposed a reliability evaluation method, neural network evaluation method, Lagrangian Method and numerical manifold method and meshless method, grey system theory, the method of fuzzy mathematics [4-7].

For the first time in the late 60's, the finite element method is used to study the stability of the slope, which provides the theoretical foundation for the quantitative evaluation of the slope stability. After 1980, with the in-depth study of the computing technology and the continuous development of the theoretical study of the mechanical properties of rock mass, a variety of effective numerical methods are applied in the research field of slope stability. 1986 FLAC method is proposed to achieve the slope stability analysis is more accurate and effective, not only can research and analysis of the large deformation problem, can also simulation specified weak sliding surface deformation trend, which can truly reflect the dynamic behavior of the whole slope internal, also can consider to external anchor, retaining wall, anti slide pile external passive the function of structure of rock, FLAC is recognized scholars as is through numerical simulation study of rock mechanics are most compelling study methods. Then the modern engineering of slope, the slope engineering geology, modern rock and soil mechanics and modern mathematics mechanics organic combination together, form a whole, and system engineering theory, number theory, information theory, fuzzy mathematics, grey theory, modern probability statistics theory, dissipative theory and mutation theory, the development of fractal theory, a steady stream of injected into the study of slope stability, slope stability analysis and calculation of the theory and method of updating more effective.

2. The Indicator System

Open-pit mine slope instability is caused by the combined effect of multiple factors; due to the different mechanism of action of various factors, making soil and rock slope failure have complexity and uncertainty. According to the results of statistical data and research, soil and rock slope failure in addition to the slope geological body factors related to, in a certain extent by the interference of external factors. This paper on the basis of previous studies, according to the national standards, industry standards, relevant literature and statistics [8-12], and combined with the engineering practical comprehensive analysis that stability evaluation level, as shown in table 1-6.

Table 1. The Geological Conditions of the Corresponding Level of Slope Stability Evaluation

Evaluation factors	Grade Ⅰ	Grade Ⅱ	Grade Ⅲ	Grade Ⅳ	Grade Ⅴ
Lithology	Very hard	hard	Relatively weak	weak	Very weak
Relationship between structural plane and slope direction	Reverse slope	Flat stacked slope	general	Slope	Down slope

Table 2. Rock Mass Strength Corresponds to the Slope Stability

Evaluation factors	Grade Ⅰ	Grade Ⅱ	Grade Ⅲ	Grade Ⅳ	Grade Ⅴ
Slope angle	＜20	20-30	30-40	40-50	＞50
Slope height	＜30	30-60	60-100	100-200	＞200
Internal friction angle	＞35	35-28	28-21	21-14	＜14
Cohesion / MPa	＞0.25	0.25~0.15	0.15-0.1	0.1-0.05	＜0.05

Table 3.The Influence of Water Corresponding to the Slope Stability

Evaluation factors	Grade Ⅰ	Grade II	GradeIII	GradeⅣ	Grade V
groundwater	none	Micro-	Weak	Stronger	Strong
Surface Water	none	Micro-	Weak	Stronger	Strong
Maximum daily rainfall	<20	20~40	40~60	60~100	>100
Erosion of slope angle	none	Micro-	Weak	Stronger	Strong

Table 4. Blasting Vibration Factors Corresponding to Slope Stability

Evaluation factors	Grade Ⅰ	Grade II	GradeIII	GradeⅣ	Grade V
Blasting vibration	none	Micro-	Weak	Stronger	Strong

Table 5. Human Factors Corresponding to Slope Stability

Evaluation factors	Grade Ⅰ	Grade II	GradeIII	GradeⅣ	Grade V
Human factors	none	Micro-	Weak	Stronger	Strong

Table 6. Design Factors Corresponding to Slope Stability

Evaluation factors	Grade Ⅰ	Grade II	GradeIII	GradeⅣ	Grade V
Design factors	none	Micro-	Weak	Stronger	Strong

3. Evaluation Model

3.1. Establishment of the Evaluation Factors

Set affect the level of open-pit mine slope stability level evaluation index factor sets:

$$U = \{u_1, u_2, \cdots u_p\} \tag{1}$$

p is the number of evaluation, respectively u_1 as geological conditions u_2 as rock mass strength, u_3 operational factors, u_4 blasting vibration, u_5 the effect of water, u_6 design factors. Analytic Hierarchy Process proposed a set of decision-making methods, mainly used in decision-making under uncertainty and the problem of having multiple assessment criteria. It is based on the relative importance of each evaluation index to determine the weights of evaluation index by pairwise comparison, while the use of Saaty given scale method to make complex, disordered qualitative problem can be quantized. Table 7 shows the importance of the Analytic Hierarchy Process division situation.

Table 7. Proportional Scale Table

relative importance	Scale values	Explanation
equal importance	1	two comparison methods are equally important
Somewhat important	3	slightly Preference one party
Obviously important	5	strongly preferred one party
Very important	7	strong preference for one party
Extremely important	9	sufficient evidence to prefer one party
adjacent intermediate	2,4,6,8	Require the use of compromise

Table 7 reflects the relative importance of the two evaluation index scores, such as an index u_i relative to the other indexes u_j slightly important, the evaluation index u_i relative comparative evaluation index u_j score of 3, which in turn evaluation index u_j relative comparative evaluation index u_i score of 1 / 3.

3.2. The structure of the judgment matrix

Using expert scoring average method to construct judgment matrix as:

$$S = \begin{pmatrix} 1 & 3 & 5 & 5 & 3 & 7 \\ 1/3 & 1 & 3 & 5 & 5 & 7 \\ 1/5 & 1/3 & 1 & 3 & 1/3 & 3 \\ 1/5 & 1/5 & 1/3 & 1 & 1/5 & 1/3 \\ 1/3 & 1/5 & 3 & 5 & 1 & 5 \\ 1/7 & 1/7 & 1/3 & 3 & 1/5 & 1 \end{pmatrix}$$

Maximum eigenvalue of the matrix calculation with the Matlab software:

$$\lambda_{\max} = 6.6987$$

$$CI = \frac{\lambda_{\max} - n}{n-1} = \frac{6.6987-6}{6-1} = 0.13974$$

We Find the appropriate random consistency index RI . On $n=1,\cdots,9$, gives the value RI as shown in table 8.

Table 8. Value of RI

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

RI is 1.24, Random consistency ratio CR=0,1127, Slightly more than 0.1, the consistency is not very satisfactory, maximum eigenvalue corresponding eigenvector as $d = (0.7559, 0.5537, 0.1602, 0.0707, 0.2886, 0.0895)$, Do the normalized processing as $d_0 = (0.3940, 0.2886, 0.0835, 0.0368, 0.1504, 0.0466)$. From the point of the calculation results, the geological conditions and rock mass strength has a great influence on slope stability in open-pit mine, the influence of the second water also is an important factor that not allow to ignore.

3.3. Entropy Weight Method

Entropy as a thermodynamic concept originally, in 1948, Shannon was the first to introduce it into information theory, entropy communication process he CITIC source signals called entropy, ie, information entropy, to indicate the stability of the system, uncertainty and information. From the second law of thermodynamics, it will not cause any change to reduce the entropy of an isolated physical system. In 1957, based on this law of increasing entropy constant, Jaynes proposed principle of maximum entropy (POME) in statistical mechanics, he believes that the ill-posed problem all feasible solutions, the largest of which a solution should be selected entropy. Maximum entropy, mean information with respect to the unknown, it was explained that under conditions of limited information most objective, unbiased. If the definition of random events possible outcomes, the probability of each outcome appears to $p_i (i = 1, 2, 3, \cdots n)$.

$$H = -\sum_{i=1}^{n} p_i \ln p_i \tag{2}$$

The entropy entropy H reflecting the richness of substance or complexity within the state system to measure the amount of information of this event, is a state function. (1) it can be seen from the formula, $p_i = 1$, it is not uncertainty $H = 0$; if the event is equal probability event ($p_i = 1/n$) to obtain the maximum value $\ln n$, the experimental results indicate nothing about the uncertainty of the biggest events.

n Pending evaluation of samples, n evaluation indicators, there are evaluation sample matrix as $X = (x_{ij})_{nm}$.

$$X = \begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{pmatrix}_{nm} \tag{3}$$

The matrix is normalized to give a standard matrix:

$$v_{ij} = \frac{x_{ij} - \min_i(x_{ij})}{\max_i(x_{ij}) - \min_i(x_{ij})} \tag{4}$$

For small person type for optimal cost indicators, there is

$$v_{ij} = \frac{\max_i(x_{ij}) - x_{ij}}{\max_i(x_{ij}) - \min_i(x_{ij})} \tag{5}$$

The j indicators entropy H_j is defined as:

$$H_j = -t\sum_{i=1}^{n} f_{ij} \ln f_{ij} \tag{6}$$

t as the adjustment coefficient, in order to make $0 \le H_j \le 1$, When $\max_i(x_{ij}) = \min_i(x_{ij})$, that is, when the n sample values in the index exactly equal; $H_j = 1$ .when $f_{ij} = 0$, $f_{ij} \ln f_{ij} = 0$; whereby entropy as:

$$w_j = \frac{1 - H_j}{\sum_{j=1}^{m} (1 - H_j)} \tag{7}$$

Then we can get $H_j = (0.6188, 0.4674, 0.7665, 0.9401, 0.5959, 0.8275)$, and $w_j = (0.2137, 0.2986, 0.1309, 0.0336, 0.2265, 0.0967)$.This shows that the main factors affecting the stability of the mine is open pit slope rock mass strength, the impact of the geological conditions and water is also an important indicator.

4. Algorithm for Instance

4.1. Engineering Geology

Mine location tectonic position belonging to Yangtze block, the base area for the Fort IV Jinningian consolidation, Sinian - Middle Triassic development of a more uniform shallow marine sedimentary cover, the Cenozoic sedimentary evolution basin, surrounded by arcuate fold cap. Panxi rock with iron sheets for the Younger Generation gap formation is late magmatic differentiation of large deposits.

Located yak Mountains foothill fringe, is Nyainqentanglha Duan Mts, construction erosion landforms. Lying West High East low elevation above sea level 1510 ~ 2270m. Exposed in the stope mainly Quaternary strata in the Upper Pleistocene (Q2-3gl) glacial deposits, gabbro (U), diabase (βμ) and vanadium-titanium magnetite, its geological characteristics points as follows: a, Pleistocene (Q2-3gl) Quaternary glacial deposits in the upper layer, the layer thickness of 39.00 ~ 190.00m, sallow color, purple brown, dark gray; consisting of boulders, gravel, crushed stone, silty clay, silt, etc. Boulders, gravel and crushed stone particles with diameters ranging from a few centimeters to as much as several meters ranging shapes, there are flat, sub-rounded, angular and other times. Content of the composition of the material is very uneven, very different. b, gabbro (U), gabbro of surrounding rock ore, NEE direction, south east orientation. Gabbro has heterogeneity, alteration is widespread, and the late dikes interspersed shallow grave degree of weathering of rocks loose, fine to medium grain structure. c, diabase dikes (βμ), a thickness of less than 33m, mainly to help North West stope help partial segment, other dikes were found. d, and ore mining group, according to data exploration, ore body thickness of 140 ~ 420m, medium grade.

Fault fracture zone, interlayer extrusion zone and diabase dikes so easily weathered, with a choice of rock weathering characteristics, there is a strong interlayer weak weathered rock weathering, the formation of abnormal structures of weathering crust, deep rock stope shallow weathering, all weathered zone thickness 0 ~ 5m, has revealed deep rock weathering, weathering zone thickness of up to 20 ~ 30m; at the near surface weathering strong, as the depth increases, the degree of weathering gradually weakened regolith thickness 20 ~ 30m. Because rock stope undergo a long-term geological and tectonic, criss-crossing fractures, fracture widely developed, interspersed with various types of dikes cutting, physical weathering provides good conditions, coupled with significant erosion in the area of climate, exacerbated physical weathering, accompanied by chemical weathering of surface water will be so easy to form rock weathering mezzanine poor mechanical properties. Mine Rock due to the different composition of rock heterogeneity, all types of rock, the combination of different intrinsic, its weathering resistance is also different. In the main surface weathered weathering, was covered weathered style, all weathered layer is thin, strong weathered layer partly thick, uniform layer of weakly weathered and slightly weathered nature, but because of fractured zones and a variety of easily weathered dyke , often forming weak interlayer, having the option weathering characteristics. Distributed in stope diabase with chlorite alteration due to the strong influence of wind resistance is poor, prone to rock granular disintegration was sand-like, rock is granular structure, stope whether or soil slope have weathered rock slope cracks, slope structural fissures exist in the body, because the rock fissures, tension cracks along the infiltration of surface water erosion or slope cutting slope, slope accelerated weathering damage.

4.2. Analysis of Field Monitoring

On-site inspection found that the upper part of the slope angle of the slope Ⅰ step extrapolation adds 1.5m, while a plurality of steps appear tumbled flowering. Ⅱ slope sliding and no cracks phenomenon, the overall relatively stable. Presence slope Ⅲ obvious cracks and dislocation, a width of about 15cm, up to 2m deep cracks appear. Transverse cracks appeared along the slope Ⅳ stepped surface direction (at about 20m after the step edges), and there are cracks in the soil on both sides of dislocation, traction There are several small crack near the main crack cracks slit width of about 35cm, about 70cm in the vertical displacement , showing the depth of more than 2m, the crack length of about 130m, northwest direction, each step up and down through the cracks, cracks southwest significantly greater than the southeast, crack height has about 4m, the average daily increase 4-5cm, crack width increases every day 2-3cm, maximum elevation change of crack reaches 60cm / day. Slope Ⅴ two steps down the stairs appeared to sit deep slope collapse tread frontier phenomenon of 1m[13]..On the slope above field monitoring results in the following table

Table 9. The Field Monitoring Data

side slope	Slope angle	Slope height	Internal friction angle	Cohesion	Daily maximum rainfall
slope Ⅰ	50	30	25	0.25	90
slope Ⅱ	38	96	35	0.19	70
slope Ⅲ	25	60	29	0.08	60
slope Ⅳ	48	85	15	0.22	100
slope Ⅴ	36	142	42	0.1	30

The membership function of each influence index is obtained by using the method of assignment, and the membership function of each influence index is obtained, the slope angle as:

$$\mu_1(x)=\begin{cases}1, x\le 20,\\ \dfrac{50-x}{30}, 20<x<50,\\ 0, x\ge 50.\end{cases}$$

Total height of slope as:

$$\mu_2(x)=\begin{cases}1, x\le 30,\\ \dfrac{200-x}{170}, 30<x<200\\ 0, x\ge 200.\end{cases}$$

Angle of internal friction:

$$\mu_3=\begin{cases} 0, x \le 30, \\ \dfrac{x-30}{5}, 30 < x < 35, \\ 1, x \ge 35. \end{cases}$$

Cohesive force:

$$\mu_4\begin{cases} 0, x \le 0.05, \\ \dfrac{x-0.05}{0.2}, 0.05 < x < 0.25, \\ 1, x \ge 0.25. \end{cases}$$

Daily maximum rainfall:

$$\mu_5=\begin{cases} 1, x \le 20, \\ \dfrac{100-x}{80}, 20 < x < 100, \\ 0, x \ge 100. \end{cases}$$

The data is brought into the membership function, and the single factor evaluation matrix is obtained.

$$R=\begin{pmatrix} 0 & 1 & 0 & 1 & 0.125 \\ 0.4 & 0.6118 & 1 & 0.7 & 0.375 \\ 0.8333 & 0.8235 & 0 & 0.15 & 0.5 \\ 0.0667 & 0.6765 & 0 & 0.85 & 0 \\ 0.4667 & 0.3412 & 1 & 0.25 & 0.875 \end{pmatrix}$$

By using the analytic hierarchy process, the weights of the 5 factors are obtained $A=(0.2, 0.1, 0.15, 0.3, 0.25)$ Weighted average model was used to calculate as $B = A\square R = (0.4313,0.5949,0.4190,0.3360,0.5712)$, after normalized processing as $\tilde{B}=$ $(0.1833,0.2529,0.1781,0.1428,0.2428)$. $\tilde{B}$ is the evaluation results of five slope samples, according to the maximum membership principle knowledge, slope II is the most stable, followed by slope V, once again I slope slope III and slope IV poor stability.

4.3. The Main Reason Analysis

Landslide means rock slope on the face of sliding down a slide. The sliding surface is usually weak surface formed by a variety of geological structures, and weak surface unstable and weak interlayer water swelling rock face formed. Very unstable and weak interlayer water swelling rock face may produce a large surface area along a weak fall. When the tendency of surface structure, to be consistent with the slope, the inclination angle is less than the slope on both sides of the sliding body with free surface or other structure to be mined - when the lower face, prone to rock fall phenomenon. Causes stope slope sliding a lot, but the main reason there are geological conditions, but also affect the design, operation, weather conditions and other factors. Quaternary landslide due to arc coating layer has a thicker rock slope is very common, Quaternary overburden soil formation approximate arc-shaped slip surface. On the rigid-plastic soil slope, as there is some maneuvering license velocity field, so did the external load power equal to energy dissipation rate, the soil damage. Such landslides are generally subjected to creep deformation slope angle, after the landslide margin expansion and landslides in central rifting fault slip bed through three stages. Its pre slow development, accelerate the development of the late, great speed landslide. This is consistent with the appearance of deformation and failure of mine landslide case. From the slope profile analysis, the depth of this landslide may occur is not too deep, slope Ⅲ has to be close to bedrock, bedrock slip arc only in the upper part. Sectional direction orthogonal position and slope, based on the existing drilling to determine soil and rock boundaries, preliminary determination of the sliding surface. From the destruction of each step, the emergence of many flowering soil situation, the Department cannot afford a result of soil stress out of extruded plastic deformation, it can also explain the slip curve is not deep. Calculated from the slip arc predictable landslide volume estimated at around 500 000 m3. Currently after landslide margin rifting expansion accelerated landslide central slide bed has broken through the whole landslide has fallen off the parent, the main slip surface is relatively flat, when the leading edge of the front pushes the forefront of the pile due to the increasing amount of increase, in Slope ⅰ a level now have a big wide platform, but the following is bedrock, in the absence of water (before the rainy season) when the leading edge of the pile increasing emphasis will be formed only thrust (similar to the pressure foot), pushed forward speed will slow down and possible new equilibrium.

The geological conditions of unfavorable factors as:

1) Analyze from a cross-sectional view, which tends to slope and rock tendencies, which belonged to the forward slope, slope in front of the airport when there is Ⅰ, because front of the presser foot weight, very easy to decline.

2) Soil conditions from the point of view of each step, from west to east gravel boulders were significantly reduced while increasing the amount with silty soil, the soil in the same up and down stairs alone colors are very different, indicating that the soil overall mechanical properties deteriorate.

3) Due to the presence of structural fissure water and topsoil Quaternary moraines pore water, combined with slope Ⅳ drainage system is not perfect, do not rule out infiltration of surface water and groundwater activities also affect the stability of the slope of the soil.

4) From the point of view of slope Ⅳ already excavated, the exposed rock is from west to east, is the natural terrain from west to east, one in the east to the transfer belt prone to geotechnical weak side, two on the eastern side relatively flat terrain of soil physical properties of naturally hearing.

Human Factors as：

1) As a result of the exploitation stage, although the overall slope angle substantially stepped control within the design range, but mostly in a single step slope angle of about 60 °, and even umbrella canopies appear to increase the weight of the stairs; top of the hill slope and stepped foot lines are jagged, very irregular; oVERBREAK and its base is serious, very easily lead to the collapse of a single step across.

2) The security, cleaning one platform irregularities; the second is the platform Rolling Stones, collapse of the soil is not as clean-up; Third, pumice soil loose and slope on no treatment, when there is water in the soil water Che exist after the body slowly to the topsoil and cranny in infiltration, reduced soil strength.

3) Blasting vibration on the stability of the slope will have an impact. Slope rock mass at the moment of blasting vibration, impact shock wave blasting action to

spread around, and when the compression wave reaches the free surface slope, began to produce tensile wave that stretched the role of rock and soil, it may make rock original soil cracks open, expand or create new fissures, resulting in rock mass deformation or destroyed. When the slope deformation has occurred, blasting vibration deformation and destruction will accelerate. Especially because of large aperture blast hole, meter dose and some charge capacity, coupled with ultra-deep grave, while blasting frequently, jeopardize the stability of the slope is increased.

Design factors as:

1) Design units stope slope design deep enough, the transfer of geotechnical slope with how the transition process did not make any weak zones account. At the same time in the selection and select the slope angle of the slope parameters of technical support is not enough, just press the ore, the soil is divided into two categories, did not make full use of the existing geological research results and exploration data broken down slope calculation .

2) Mining design stage, the designer did not consider the location of the staging of the slope engineering geological conditions and in terms of selection and selecting the slope angle of the slope parameter is too simplistic.

4.4. Treatment Measures

For the destruction of soil slope, slope cutting decompression using Slope weight loss, inhibit the occurrence and development of further landslides, slope instability body control activities is the most effective and most economical conventional measures. Carried down from the slope cutting decompression Slope weight loss, following the first fixed. In order to prevent water from entering the rainy season, the soil, the soil surface to be treated. Load pressure foot also inhibit further development and progression of landslide, slope failure effective means to control the activities of the body. According to forecasts will slip curve slope Ⅰ first platform southward extrapolation 30m, which has four purposes: First, to remove damage body; second is to provide a platform for an upper level of job security; third is to greatly reduce the level of slope angle, to improve the overall stability; Fourth, it is so good to slope stability can. stepped slope design parameters: the width of the platform were 8m, 8m, 12m (8m wide cleaning operation can be performed), phase slope angle 40º, three steps as a group, the slope angle of 27 ° (slope bottom to its base). when handling slippery slope cutting decompression body to be stepped slope processing steps to minimize weight. While forming cut drains. formation of a new stage of excavation, in accordance with a single step in soil slope angle 40 °, step height 12m, plus a security platform with two platform for a combination cleaning step, secure platform width 8m, sweeping platform width 12m, the final step slope angle of 27 °. The slope Ⅳ platform infer slide within the arc and the upper large traction crack soil Clear All. While the slope above the highway re-laid Ⅳ explore, Ⅳ Platform will also south slope about 30m, the slope above the main level Ⅳ binding pioneering road construction program. Consider first the job during the day, and set up observation posts, were found when the insurance case officer immediately removed. Before the landslide job security personnel to carefully check the surrounding water systems to prevent water from entering the landslide. All incoming landslides workers must be targeted safety education and training. Before the rainy season must have stepped on the slope Ⅴ disrupted soil anti-seepage treatment, and good interception and drainage work.

5. Conclusion

Open pit mine slope stability influenced by many factors, commonly used methods can be divided into subjective weight and objective weighting method. The former is a qualitative analysis method, which is based on subjective preferences and experience of decision-makers are given the index weight, such as Delphi method, AHP, fuzzy evaluation method; the latter is a quantitative analysis method, it is based on data and indicators their intrinsic properties derived, ignoring the knowledge and experience of decision-makers, such as entropy method, similar to the number of similar rights law, variation coefficient method. In this paper, AHP and Entropy Combination manner, first-level indicators of the impact of open pit slope stability of mine comprehensive evaluation using AHP method given in open pit mine slope stability influence factor weights, and then use the right method to calculate the entropy the factors to overcome the shortcomings of AHP index numbers do not reflect the characteristics of and the need for consistency check and bypassing the AHP method when less than satisfactory consistency need to adjust the judgment matrix cumbersome, the conclusions of reliability and science, using matlab programming also greatly improved operability. Through field monitoring by assignment method, trapezoidal distribution, obtained membership function of each impact indicators, according to the principle of maximum membership concluded that the most stable slope Ⅱ, Second slope Ⅴ, Ⅰ slope again, slope and slope Ⅲ ⅳ poor stability, this result is consistent with the on-site inspection.

Acknowledgments

This work was supported in part by Sichuan Provincial Department of education project(12ZB115),Sichuan Provincial Administration of Work Safety (Coal Supervisor Bureau of Sichuan) production safety projects(Scaqjgjc_stp_20150013).

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