

## Stability Analysis of Deposit Slopes

Shenzheng Ma <sup>1, a</sup>, Yanyang Zhang <sup>2, b</sup>, Zihe Shou <sup>1, c</sup>

<sup>1</sup>School of Sichuan, Southwest Petroleum University, Chengdu, 610500 China

<sup>2</sup>Mine Bureau of Sichuan, 405 Geological Team, Dujiangyan, 510000, China

<sup>a</sup>mashenzheng@163.com, <sup>b</sup>1135594939@qq.com, <sup>c</sup>1025533017@qq.com

### Abstract

**Aim at to usually meet in the local engineering construction of deposit slopes problem, combine the geology phenomenon that the spot survey sees in the earth's surface, and drill a hole rock Xin data, in analyzing the foundation under conditions, such as district geology environment and rainfall...etc., to the stability that piles up deposit slopes carried on a macro view settle sex evaluation. Settle the foundation of sex evaluation in the macro view up, adopt the principle of number analysis, to slope at under the natural work conditions, such as status, rain-storm and earthquake...etc. of the stability carried on an analysis evaluation and got the different calculation method gets of the different work condition fall ascent pile up the stability coefficient of body. Analyze to compute the achievement constucts for the engineering of smoothly progress with possible under the work conditions like rain-storm, etc of the part reinforce a processing to provide a reasonable basis, and provide a reference for the same kind stability evaluation for piling up deposit slopes.**

### Keywords

**Deposit Slopes, Settle Sex Evaluation, The Number is Analytical, Stability Coefficient.**

### 1. Introduction

At our country southwest region, because of geology activity active, cause of collapse, slippery ascent, and mudslide...etc. the shallow layer form living geology disaster often occurrence [1-4], from slippery the ascent pile up, collapse to pile up, the ascent accumulate thing etc. to constitute of lax the slope piling up a body would be an extremely important engineering geology problem [5-8]. Many researchers [4, 6, 9-13] to some becoming of slopeses that is large to pile up a body because of the mechanism, space effect, transform to break characteristic and stability to carry on detailed analysis, express that this slope transforms destructive growth scale to usually be subjected to a special geology condition a control as a result, express bigger difference, don't exert a homology as well to the influence degree of the engineering. Therefore, according to geology condition as to it's become because of mechanism, break the mode and stability carries on in detail analysis research have very important meaning, relate to constuct engineering a work of develop smoothly and the safe movement of engineering [10,14-15]. This text with some water electricity station pile up deposit slopes for example, on the spot detailed investigate of foundation up, analytical it become because of mechanism, counteract qualitative analysis and fixed amount evaluation combine together of method as to it's the stability carry on completely, the evaluation of science, can be engineering construction of smoothly progress and rain work condition under possible of the part reinforce processing to provide a reasonable basis, and pile up a deposit slopes stability evaluation to provide a certain reference for the same kind type.

### 2. Pile up body stability qualitative analysis

#### 2.1 The slippery ascent piles up a body

Pile up body flat surface's area about the 7.21 ms<sup>2</sup>, the overlay layer thickness doesn't wait for 3~30 ms. Pile up body lower part with contain Li and glue soil for lord, medium upper part with crushed stones hybrid soil is lord, it is thicker (about the 30 ms) to pile up before the thing good luck, empress

the good luck pile up a thing thinner.(BE 3~5 ms) Descend the Fu radicle rock strong breeze to turn to take inside there is a mire turning mezzanine to distribute, but the coherent is worse, only see the ZKM1, ZKM4 drill a hole, the weak morals and custom takes to have thick 3~5 cm mire to turn mezzanine to distribute inside the part.Take to distribute depth and run-through analysis from the glide, add previous good luck to have no glide to shear a geography condition, pile up a body again follow bottom occurrence glide of the possibility isn't big.Pile up before the body good luck part occurrence to probably fall to slip a phenomenon under the rain-storm circumstance.

Geology survey in the ground didn't discover two sides and empress good luck boundary transforming an evidence and only faced sea son before the ditch good luck abrupt hole to have part to collapse to fall to transform an evidence.According to the survey, the slippery ascent takes place up to now already the 37 years, upper part farmland and common people's houses have never seen currently the crack and Ru change phenomenon, 1# piles up whole ascent noodles of body and doesn't discover glide to break a phenomenon.

Gomprehensive geography geology condition and survey result analysis, those 1# slippery the ascent body is whole to be placed in to stabilize status under the state of nature.

## 2.2 The 2# slippery ascent piles up a body

Pile up the body flat surface area 6.22 ms 2, the overlay layer the thickness 1~15 ms doesn't wait.The 2# slippery ascent piles up before the body good luck and 1# to pile up a body close by, incise depth because of the sea son ditch opposite more deep, front good luck the abrupt hole become Gao, geography condition to stabilize disadvantageous influence.Pile up body upper part to take crushed stones hybrid soil as a lord, the thickness 1~5 ms, have never glued sex soil mezzanine to distribute, medium the lower part have already contained Li to glue soil and glue soil to clip a crushed stones layer.The lower part radicle part inside the rock has mire to turn mezzanine to distribute, but the coherent is worse, only see the ZKM10 drill a hole, the weak morals and custom takes to have the 3~5 cm the mire to turn a phenomenon inside the part.Follow to pile up body bottom again occurrence glide of possibility isn't greatly, under the rain-storm circumstance, pile up before the body good luck shallow layer part probably occurrence fall slippery phenomenon.

The slippery ascent piles up a body two sides contain the abrupt hole geography that Gao 1~3 ms doesn't wait, east the flank field and empress good luck didn't transform an evidence, but west flank field it is thus clear that several cracks(see figure 1), the abrupt hole has part to collapse to fall to transform an evidence.According to the survey, the slippery ascent takes place up to now already 32 years, piling up the upper part farmland in body didn't see obvious crack, but ascent the good luck present tongue-like in shape extension geography before the body, the part has the Ru slippery phenomenon.



Fig. 1 2#Landslide deposit on the western edge cracks

From there has been geology data and survey result analysis, should slip an ascent to pile up a body to be placed in basic stability status currently, but west flank good luck the part still have already transformed a phenomenon.In the rain-storm or open to dig ascent feet under the circumstance, may arouse to pile up before the body good luck to transform to fall to slip.

## 2.3 The central part changes body

Pile up to lift central part to transform a body, according to investigating to show to transform the body investigates to explore to have no inside the depth the place the slope lower part radicle rock

slippery take existence, only develop 2 agreeable layers slow Qing ascent outside wrong move to take. Being total because of geography slope and radicle rock crest noodles slope is more slow, and wrong move to take have never faced empty, the radicle rock doesn't have a slow Qing ascent of follow outside wrong move to take slippery the condition for moving. The slope stability problem fastens the stable problem of slope overlay layer. According to the rock soil structure characteristic, rich water characteristic of slope, transform a characteristic, the slope stability problem fastens the stable problem of slope overlay layer. Transform a body to transform to fill on the above of the soil because of the roadbed a heap of residue adds to carry a function to make a soil ascent to the ascent crest creation the occurrence shear to slice to transform and transform slippery move the direction as S of 60 °Es, the raining season soil body saturation, the mechanics property is bad, transform more obviously. Transform a body to transform for the partial stability problem of slope, transform body place the natural slope Be whole to be placed in to stabilize status.

### 3. Pile up the deposit slopes stability fixed amount evaluation

According to water electricity water conservancyslope design norm (DL/T5353-2006), slope stability's analyzing a basic method is an extreme limit balance limit solution method, adopt a Slide mold piece within Rocscience system software, carry on a stability analysis calculation. When adopt various methods analysis calculation, dissimilarity bottom limit solution method in should take the value of tallest achievement, but should not exceed the upper limit solution lowest value within method, the M-P method(Mo root Si Tan method) computes to be worth in the Rocscience software generally higher, and the method is slope norm recommend of strict solution method, therefore finally make reference to finish the method of Xiao Pu and Zhan Bu simplify a method result, with Mo root Si Tan the method compute result Be slippery ascent stability safety evaluation basis.

The in common use method of the slope stability of another calculation is to adopt a limited dollar method. The limited unit method is to treat research object as to lie quality in a row, pass long-lost the establishment turning a method look like function, wireless problem simplification, pass equation set to analytical transform a body of in response to dint contingency problem. This stage adoption phase software carries on stability evaluation towards piling up a body.

Survey and map and investigate to explore data according to the geology, didn't discover continuous weak rock strata in the radicle rock, and ascent the good luck sea son ditch didn't incise to a little bit deeply face empty side before the body, thought a radicle rock the geologic strata is stable currently. Pile up to lift to break the form piles up body glide for shallow layer, this is metered the calculation only calculation may arouse to pile up before the body the good luck transforms to fall to slip 2# slippery the ascent pile up of stability.

#### 3.1 The slippery ascent piles up a whole stability of body analysis

Under the different work condition the calculation model of establishment sees figure 2~3. Need to consider super hole water pressure dint under the condition in the rain-storm work among them, and dump after the deposit slopes a good luck underground water table to lift to rise. The whole stability result that computes a slippery ascent of 2# to pile up a body under the work condition according to the model sees table 1.

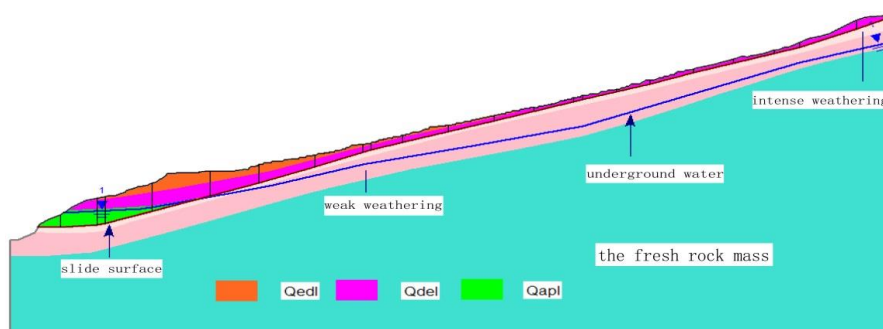


Fig. 2 Calculation model under the condition of natural and earthquake

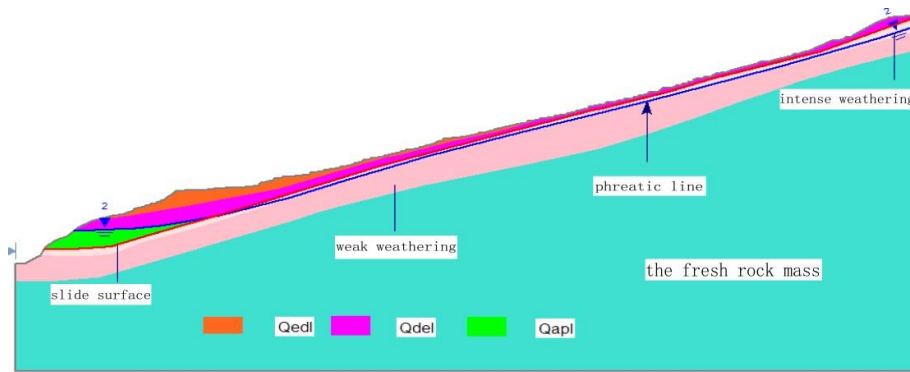


Fig. 3 Calculation model under the condition of the storm

Table 1 All kinds of the 2 # landslide deposit under the condition of the overall stability calculation results

Working Condition	Calculation Method				
	General	Bishop	Janbu	Spencer	Morgenstern
Natural	3.031	2.944	3.008	3.033	3.019
Earthquake	1.951	1.896	1.936	1.944	1.941
Heavy Rains	2.209	2.163	2.193	2.212	2.200
Earthquake + Heavy Rains	1.433	1.400	1.422	1.427	1.425

Total come to say, adopt the general cent's method calculation gets of stability coefficient opposite other method calculations get of the stability coefficient have to be a little bit low, this is because calculation method is dissimilarity from calculation principle cause. Under the natural status, 2# slips the whole stability coefficient of ascent over 2, the slippery ascent piles up a body whole ascend be placed in to stabilize status. Under the earthquake, rain-storm work condition, the slippery ascent piles up whole stability coefficient of body basically also above 2, the stability is still better. In the earthquake and the rain-storm under the common function, the 2# slippery ascent piles up the whole stability of body also above 1.4, the whole stability is good.

### 3.2 The slippery ascent piles up a partial stability of body evaluation

(1) Just body extreme limit equilibrium method.

Making use of to compute the procedure adoption arc method to search to get is natural, under the rain-storm and earthquake work condition 2# slippery the ascent pile up a body in the most dangerous slippery noodles position and stability coefficient, such as figure 4~7 show.

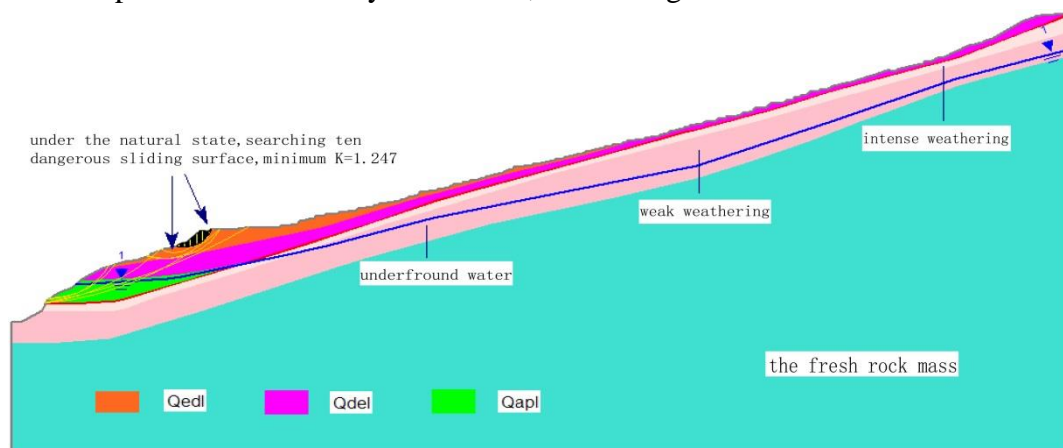


Fig. 4 Under the natural state of circular arc method 10 of the most dangerous sliding surface search

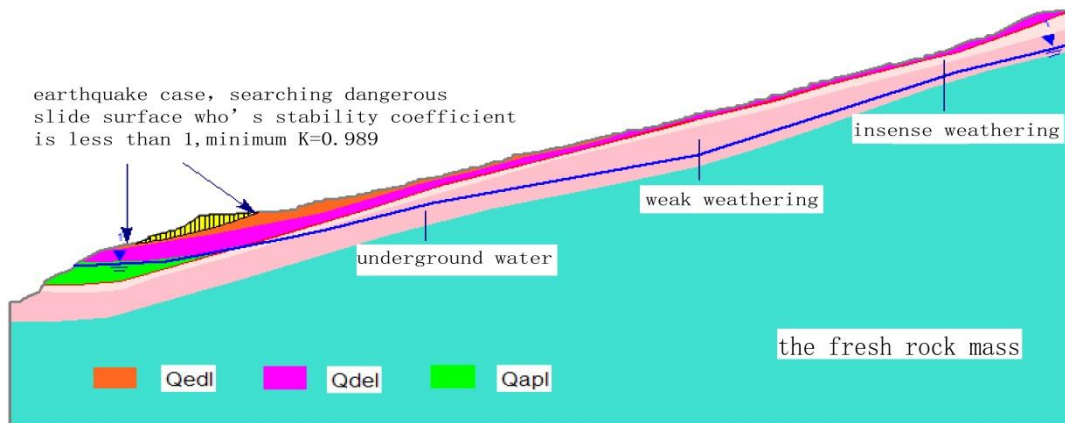


Fig. 5 Earthquake conditions arc method to search for slope stability coefficient is less than 1(a=0.165g)

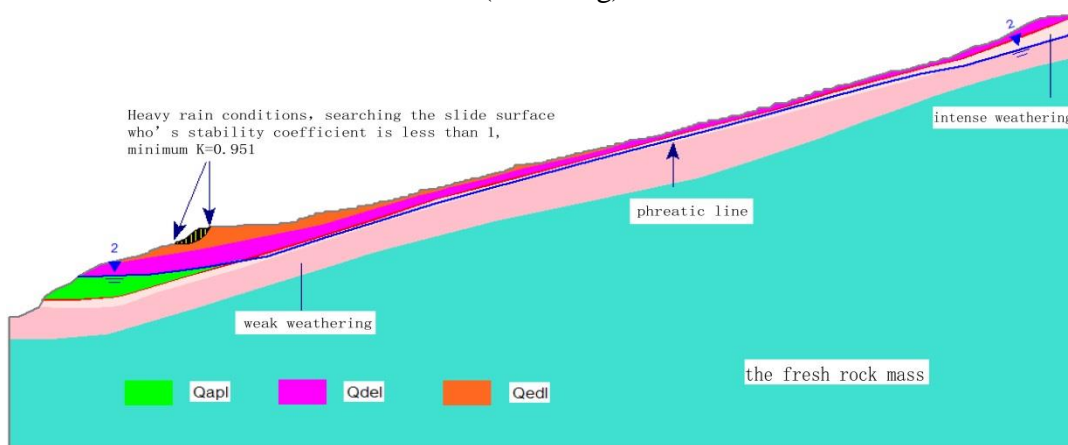


Fig. 6 Heavy rain conditions arc method to search for slope stability coefficient is less than 1

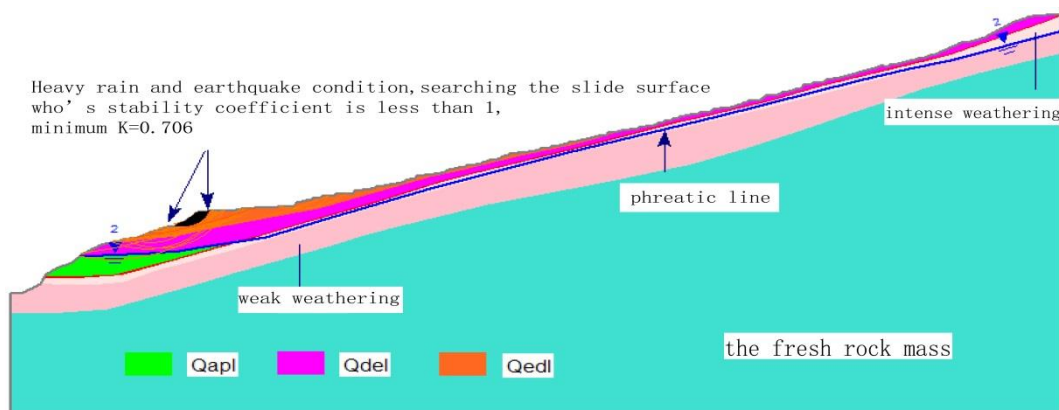


Fig. 7 Heavy rains + earthquake conditions arc method to search for slope stability coefficient is less than 1(a=0.165)

Can know from the diagram, natural status bottom, the most dangerous slippery body is located in slippery the ascent pile up before the body good luck, minimum of stability coefficient  $K=1.247$ , the stability coefficient of limited dollar calculation is 1.52, the stability is better. In the earthquake work under the condition the adoption arc method search minimum stability coefficient  $K=0.924$ , this means in the earthquake work under the condition, dumping the deposit slopes form department will appear part of lose steady fall breakage.

In the rain-storm work under the condition, the slope material is placed in saturated status and search slippery noodles in, the slippery side of the stability coefficient's least appears at slippery the good luck after ascent,  $K=0.914$ ; In the earthquake+rain-storm of extreme the work condition search the result of slipping the noodles under the condition in, appear similar conclusion with rain-storm work

condition, most the dangerous glide noodles also appears at slippery the good luck after ascent,  $K=0.668$ , enunciation rain-storm and rain-storm+earthquake etc. work condition under the condition, the slope will take place the part crash, and all and first appear at slippery the ascent pile up a body after good luck position.

(2) The limited dollar method analyzes a method.

The calculation model of establishment sees figure 8, the calculation sees figure as a result 9~12. The partial stability result that computes a slippery ascent of 2# to pile up a body according to the model under the work condition such as table 2 show.

The stability is computing a result, with just body extreme limit equilibrium method similar, and because of phase model in, adoption of was the whole slope is a model, various work condition calculation result more extreme limit the equilibrium method was higher. Under the natural status, pile up a whole of body to move vector trend obvious, moves main occurrence the surface is at the ascent body, main concentration after slope good luck and slippery the ascent pile up before the body good luck surface part, get into radicle rock inner part, moves quantity to obviously lower. Among them slippery ascent before the body good luck under the rain-storm condition's moving trend Be getting more obvious, the earthquake work condition is next the direction of inner part moving on the slope have obvious variety, is quickly changed into a level direction by the perpendicular direction.

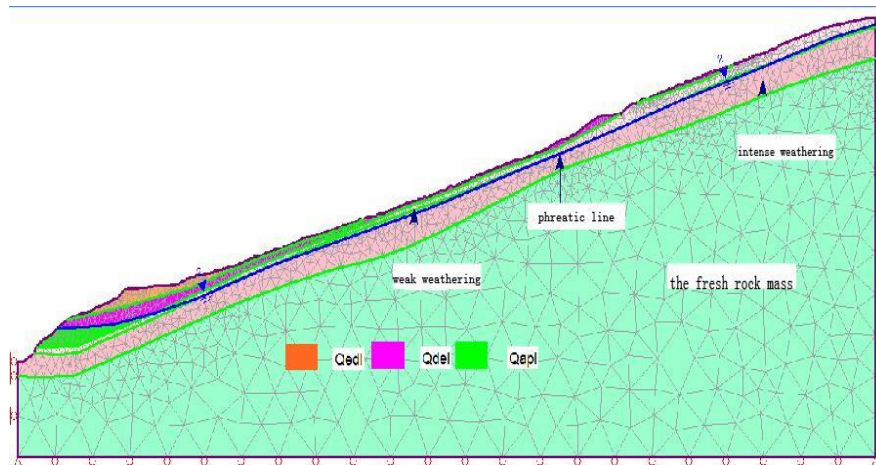


Fig. 8 Finite element analysis model of deposit

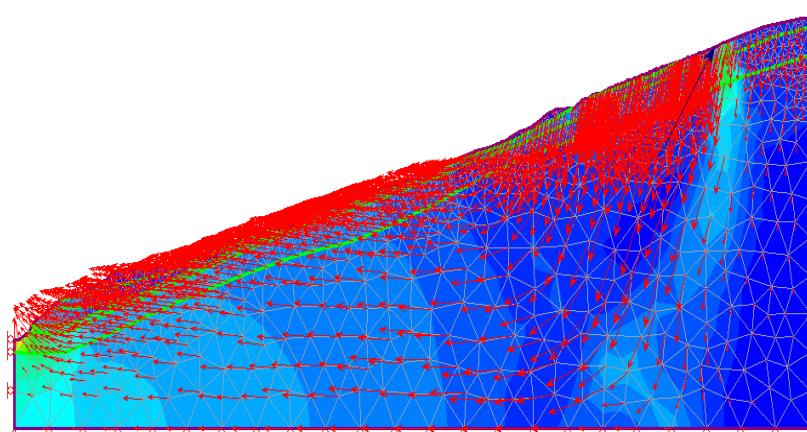


Fig. 9 2 # landslide deposit natural state displacement vector diagram

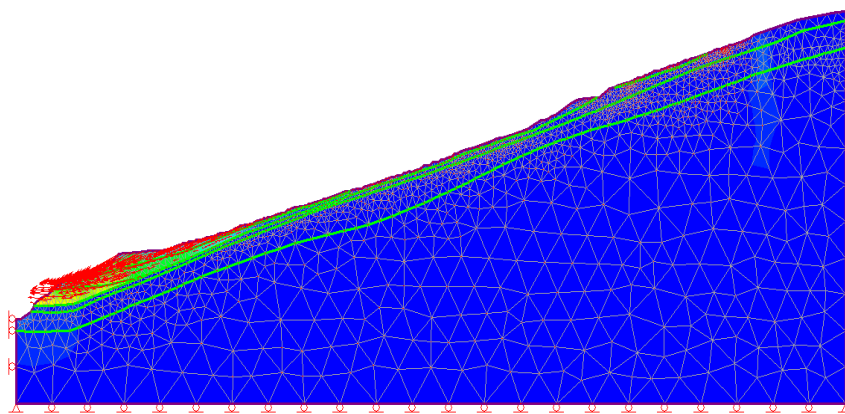


Fig. 10 Working condition of 2 # deposit landslide and earthquake displacement vector diagram( $a=0.165g$ )

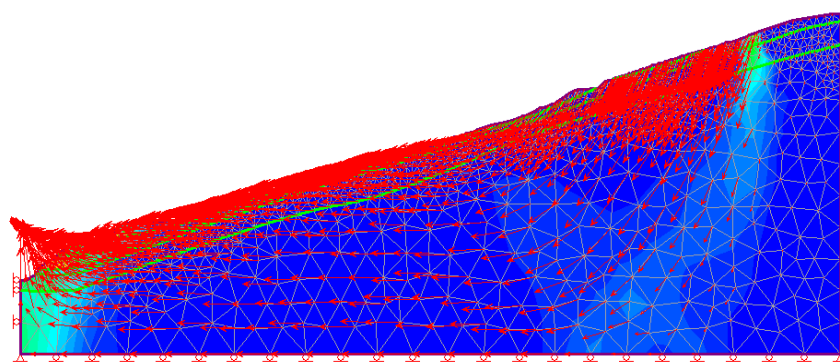


Fig. 11 2 # landslide deposit rainstorm condition of displacement vector diagram

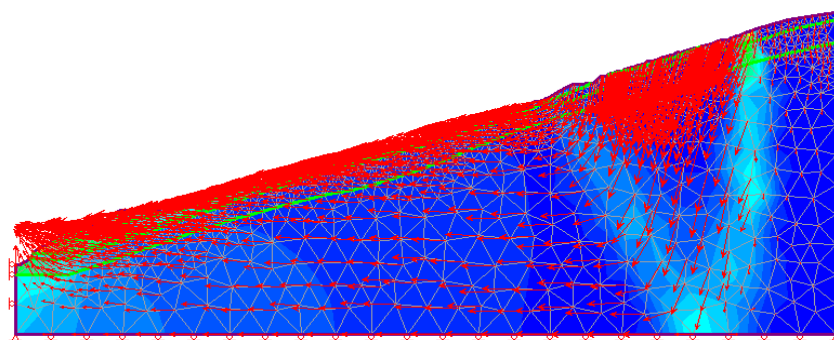


Fig. 12 2 # landslide deposit rainstorm + earthquake condition of displacement vector diagram( $a=0.165g$ )

Table 2. Calculation results for the local stability of 2 # landslide deposit summary table

working condition	calculation method					
	general	bishop	janbu	spencer	morgenstern	finite element
natural	1.259	1.316	1.247	1.317	1.310	1.53
earthquake	0.957	0.994	0.924	0.989	0.993	1.00
heavy rains	0.960	1.002	0.951	1.001	1.000	1.090
earthquake + heavy rains	0.731	0.754	0.706	0.749	0.753	0.890

Can get from the diagram, slip an ascent to pile up body breakage type Be current to pull breakage, have already shorn breakage as well. Among them shear to slice to break main concentration in the

ascent before the body good luck, and ascent body surface layer; Pull a breakage to then mainly take place after ascent body good luck, and appear to pull Zhang Dai toward the radicle rock direction part. Various work condition the contrast come to see, under the rain-storm condition of the embankment good luck appear of shearing and slicing to break more natural status the bottom is obvious; And earthquake work under the condition, the whole slope of medium embankment the department all appear to obviously pull a breakage, and extend toward the radicle rock direction, front the good luck part shear to slice to break scope to also become big and shear to slice in response to the dirt a direction to expand toward the radicle rock.

#### 4. Conclusion

To 2# slippery the ascent pile up a body to carry on stability calculation analysis in, compute the different calculation method calculation get of the different work condition fall ascent pile up the stability coefficient of body. From the number analysis and the form, get to draw a conclusion:

(1) Whole stability: Under the natural status, the stability coefficient is higher, the slippery ascent piles up a body whole be placed in to stabilize status. Combine in the rain-storm, earthquake and two kinds of work condition etc. pile up a body stability the coefficient have to lower under the condition, but basically above 1.4, pile up a body whole up still is stability.

(2) Partial stability: The most dangerous slippery side that makes use of an arc method to search to get mainly concentration at slippery the ascent pile up before the body good luck and embankment good luck and just search to get under the natural work condition among them of the most dangerous slip the stability of body of coefficient above 1.2, slippery the body be placed in to stabilize status. Search the most dangerous slippery body stability for getting under the rain-storm and earthquake work condition coefficient at 0.9-1.0 of, slippery the body part will appear to lose steady status. But under the situation that two kinds of work condition combine together, searching the most dangerous slippery body stability for getting the coefficient is between 0.67-0.89, the slippery body will appear to lose steady fall breakage, and most easily lose steady part after slippery ascent good luck, with appear under the rain-storm condition of lose a steady circumstance to is similar to.

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