Study on the selection of characteristic parameters and the location in slope monitoring

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ABSTRACT :

The landslides bring the enormous property loss and life threat to people under the effect of natural force and human activities. Monitoring is one of the most powerful means to the space-time forecast of the sliding. Because these slope structures are not always in the same way, and the factors inducing sliding affect each other, the selection of monitoring characteristics parameters and the location of monitoring region became the key points in the slope monitoring. But there is no mature theory and analytical method at present for the two problems and more researches should be needed.

The monitoring characteristic parameters and the location of sliding monitoring region are studied in the paper. At first, the deformation features of the different landslide and the structure of the slopes are analyzed and based on the results the different characteristic parameters of slope structures in different deformation stages are attained. According to the dominant deformation model, the main characteristic parameters are determined. Then, the numerical simulation technology is used in determination of monitoring location by combining a actual engineering project. The numerical model according to the monitoring object is established. The characteristic parameters are analyzed by the numerical simulation. We obtained the affecting area and the scope of the parameter variation in diverse loading stages.

KEYWORDS: Sliding; Monitoring; Characteristic parameter; Monitoring region

1. INTRUDUCTION

The landslide is frequent in China. In order to prevent and reduce the expense of lives and belongs of people which coming from landslides, it is very important to monitor the slope bodies in dangerous region and landslide early warning timely. In the past, some researchers have investigated the monitoring means and sliding judgment, but the literature about how to select the monitoring parameters is rare.

In this paper, the selecting of monitoring parameters in the view of mechanism of slope instability is performed, using the numerical analysis software FLAC locate the monitoring region using the numerical analysis software FLAC.

2.SLOPE STRUCTURE AND MONITORING PARAMETERS

According to the research results of the Northwest Branch, Academy of Railway Sciences Ministry of Railways, which include the mechanism of slope instability in the construction of mountain railways. Some researchers have proposed rock mass structure and slope structures. On the basis of these, the slope structures are dividing into six large classes, and then the slope deformation characteristic and monitoring parameters are induced.The slope structure and the monitoring parameters as fellow:

(i)The pedestal slope structure

This type exist structure surfaces significantly, which develop into the sliding surfaces when the land sliding occur. So the displacement rate and the transient displacement rate become the monitoring parameters. At the

same time upper plate should be observed closely, the objects include the crack and the superficial deformation.
(ii) The layered slope structure

The large class includes the maleic inclined layered、the inverse inclined layered、the steep inclined layered、the horizontal layered and the stratiform-like slope structures.

It is difficult to define the shear-sliding surface of the large class easily. So the deeply monitoring is needed. But the displacement rate among layers and the displacement also must be involved. ii()maleic inclined layered slope structure
(iii) The tectonic crushing body structure

In the process of monitoring, the crack development must be observed and combined with the displacement of the slope surface. So the region of sliding would be defined.

(iv) The augen slope structure

The slope structure develop sliding phasedly, the large-scale sliding followed the small-scale sliding. So the displacement of the soft-hard interface must be mainly mentioned. The monitoring parameters can be determined by different conditions.

(v) The analogy homogeneous slope structure

In the course of monitoring superficial deformation monitoring may only be in a forecasting phase. The parameters ought to use the displacement rate.

(vi) The loose body slope structure

This type slope usually generates plastic flow. The deep deformation monitoring is the key point; obviously the surface deformation is significant. So the slope surface deformation is dynamic simulated easily.

3. NUMERICAL SIMULATION AND MONTORING AREA

3.1 The module and the thought

In the section planning to apply a analyzed dam project (detailed situ testing parameters are available), the prevalence general software FLAC is applied. The analysis content includes the stress and strain status under the gravity and water pressure seepage effect. At the same time, the monitoring region of the dam's slope and the monitoring accuracy are discussed on the basis of the contours of the strain、stress and displacement.
The mechanical parameters applied in the analysis are all in the table.1

Table 1 dam body material mechanical parameters

Soil	Bulk modulus of elasticity (KPa)	Shearing modulus （KPa）	Dilatancy angle (0)	Tensile strength (KPa)
Clay	3.02×105	1.39×105	0º	50.00
Substitute material	3.09×105	1.18×105	0º	50.00
Sandy gravel	3.54×105	1.63×105	0º	0
Rubble	4.08×105	1.88×105	0º	0
Rhyolite porphyry	5.33×107	3.2×107		

The typical section of the dam as fellow::

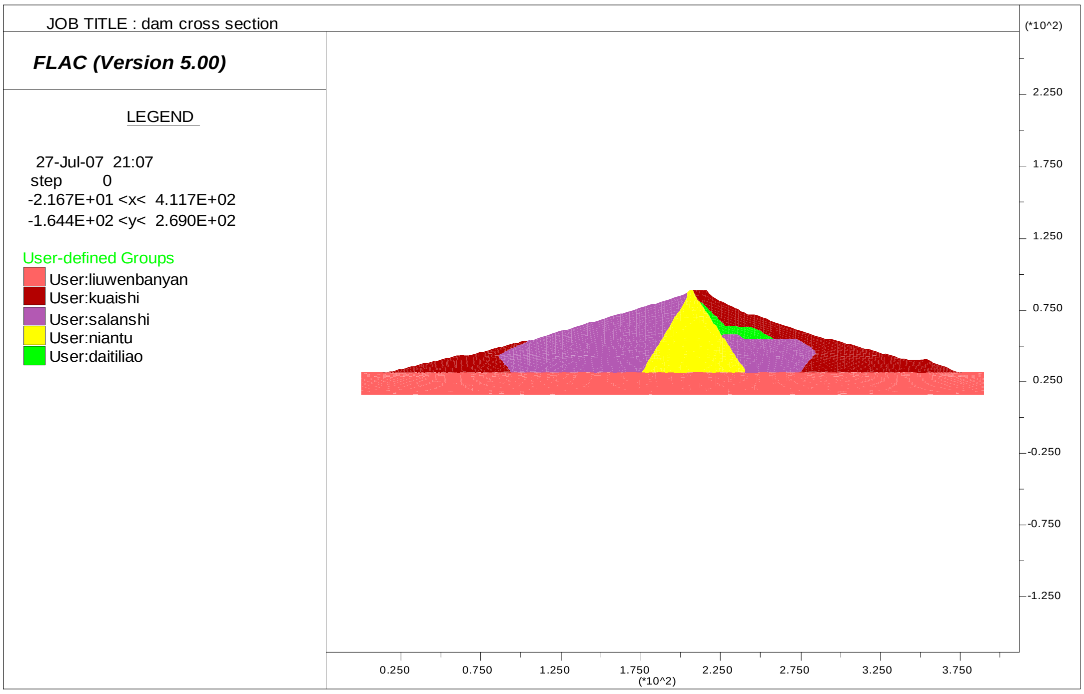

Fig.1 the section of the dam and the filler distribution

3.2 The Analysis Results

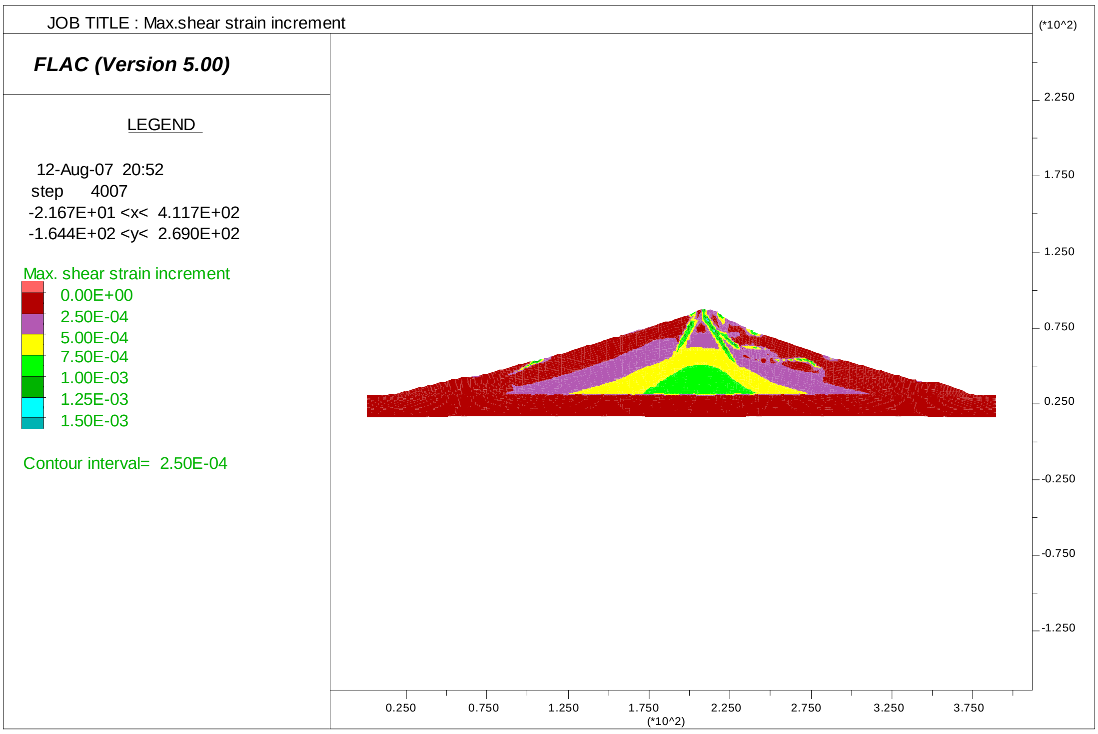

Fig.2 the shear strain increment contour under gravity

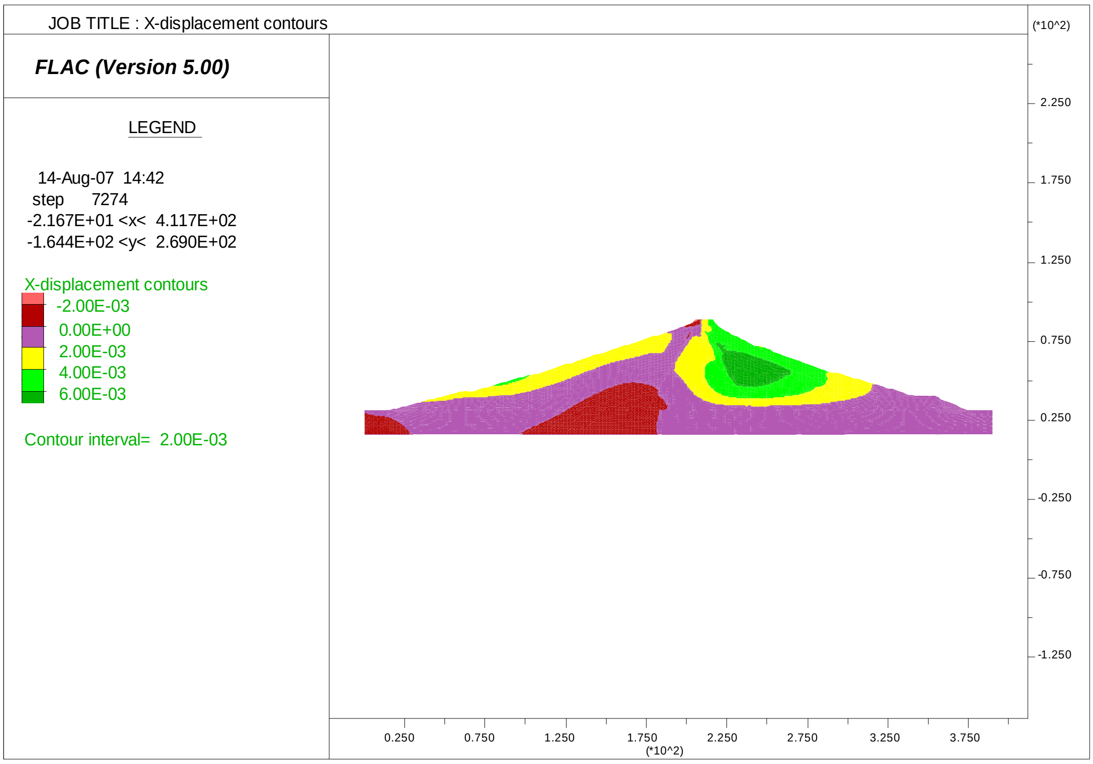

Fig.3 the horizontal displacement distribution of the dam body under water pressure

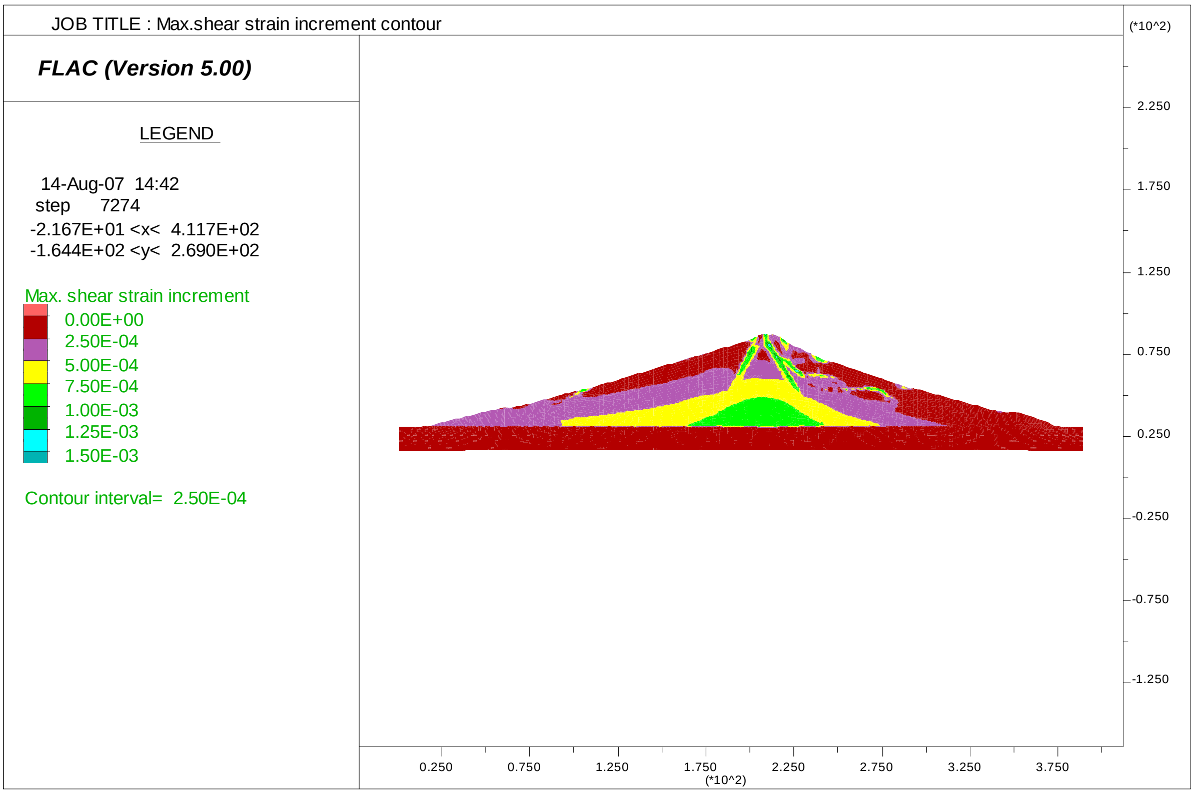

Fig.4 the shear strain increment contour under water pressure

3.3 The Monitoring Area

Using the horizontal displacement state and the shear strain state,the monitoring region and the monitoring depth may be discuss as fellow.

The horizontal displacement contour in the Fig.3 show that the most horizontal displacement occur in the range of 8 meters to 21 meters under the first plate from the dam crest in the back of dam, the horizontal range may be from 220 meters to 260 meters (from the dam foundation of the facing water slope).As indicate in the fig.3, the horizontal displacement beyond 6 millimeters in all of the control points. The load existing are the gravity and the water pressure, so the displacement is minimal. But the distribution of the displacement is typical. In the process of monitoring, the horizontal displacement must be given undivided attention in the region discussed above. Furthermore, the depth monitored must be about 25 meters under the surface of the slope. At the same time, the height measurement must be preceded on the top of the dam in case of gaining the vertical settlement.

The fig.4 show the shear strain increment contour, which indicate that the shear strain of the outer material of the dam body and dam foundation tend to 0;on the contrary ,the shear strain generate relative larger in the clay core. The binding position of the filler occurred the largest shear strain in the dam body, especially in the back slope where the filler partition complex, the magnetite up to 1.5E-3. The shear strain of the filler combination surface reach 1.0E-3 in the left dam body and the shear strain also beyond 1.0E-3 in the lower-half of the dam, comparing with these the other shear strain may be lower. So,the deformation of the clay core and the filler combination surface is the largest under the general load. In the process of monitoring practically we can only obtain the strain of the X and the Y direction and the macroscopic displacement of the filler. This conclusion can be recognized from the shear strain increment and the horizontal and vertical displacement contours.

CONCLUSION

According to the discussion in this paper, the conclusion can be drawn:

1. The key factor which controls the land sliding is the structure of the slope body; according to the structure we can select the monitoring parameters.
2. In view of the complex buckling forms of the slope, the monitoring parameters always will not be solely.
3. The monitoring region can be zoned by using the numerical analysis software, at the same time the monitoring accuracy can also be defined.
4. The back analysis could be used in the monitoring system, namely using the data obtained we can calculate the mechanic parameters which have applied in the former numerical analysis.

The monitoring means is very important, which determine the forecast system and the form of the date. But in this paper ,we do not focus on the topic which will be investigate in the future.

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