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Analysis and Treatment of Deformation Characteristics of a Landslide

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Abstract: The results show that the strong deformation area of the landslide is in a basic stable state in the natural state and in an unstable state under heavy rain conditions, and the comprehensive treatment measures of "new anti-slip retaining wall+new drainage ditch+cracked road demolition and reconstruction" are proposed.

Keywords: Landslide Deformation Characteristics; Stability Calculation and Analysis; Comprehensive Management

1. Basic Characteristics of Landslide Body

The landslide is located in Guangyuan City, Sichuan Province. Its plane shape is "circular chair-like", with a width of about 35m, an average sliding length of 5.5m, an average thickness of about 3.0m, and a cubic volume of about 580m³. The main sliding direction is about 283°. The rear edge of the landslide is located at the highway platform, and the front edge exits at the steep toe of the roadbed. The deformation manifestations of the landslide mainly include cracking and displacement of the highway pavement at the rear edge, inclination of trees on the landslide slope, and collapse and bulging of the dry masonry at the front edge (See Figure 1).

Figure 1. Landslide Panorama

(2) Deformation characteristics of landslide

Landslide deformation is mainly caused by the cracking and dislocation of the highway pavement at the rear edge of the landslide, the inclination of trees on the slope surface of the landslide, and the swelling of the dry block stone fort at the front edge of the landslide.

Specific deformation characteristics are

described as follows:

① cracks at the rear edge of landslide

There are mainly two tensile cracks at the rear edge of the landslide(see Figure 2 and 3.), in which L1 strike is about 15, the extension is about 25m, the dislocation is 2cm~8cm, and the crack is 2cm~5cm wide, which leads to the cracking of the road at the rear edge of the landslide and is the last tensile crack of the landslide. L2 strike is about 20, and the extension length is about 35m. This crack causes the road to be interrupted and the bottom of the road to be hollowed out, with an offset scarp of about 1.0 m. see Figure 4 and 5.

Figure 2. Landslide Trailing Edge L1 Crack Photo

Figure 3. Landslide Trailing Edge L2 Crack Photo

Figure 4. Crack L2 Leads to Road Dislocation

Figure 5. Crack L2 Leads to Road Subgrade Hollowing

Figure 6. The Mortar Masonry Retaining Wall at the Front Edge of Area 1 # Swells

Figure 7. Landslide Slope Surface Trees Tilt

②Dry-built bulwarks at the front edge of landslide swell.

The front edge of the landslide is a dry block stone retaining wall, with a height of about 3.5m and a thickness of about 0.5m. Under the deformation of the landslide, the retaining wall swells locally, and the bulwarks at local positions collapse. see Figure 6.

③ Slope vegetation inclines.

Signs of tree inclination can be seen in the local area of the front slope in the landslide. see Figure 7.

(3) Material composition and structural characteristics of landslide

Through field investigation and analysis, the landslide is a small soil landslide developed in residual slope, the sliding surface is arc sliding in soil, and the sliding body and sliding bed are residual slope silty clay containing gravel. the landslide front has good free air condition, and it is easy to slide as a whole under the adverse factors such as rainfall. the material composition and structural characteristics of landslide are as follows:

Material and structural characteristics of landslide body and sliding bed: landslide body is yellow-brown silty clay mixed with broken stone, slightly wet, plastic, mainly composed of powder particles, followed by clay particles, mainly composed of clay minerals; gravel content is about 10%~20%, gravel is irregular, particle size is about 2cm~5cm, and the maximum block diameter can reach 10cm. According to the field investigation, the sliding mass is thin, with an average thickness of 2.5m and only 0.5~0.8m locally, and the sliding mass is loose as a whole.

2. Landslide Hazards

At present, there are obvious deformation signs of landslide, such as cracking of roads leading to villages at the rear edge of landslide and bulging of dry block stone retaining wall at the front edge. Combined with the deformation signs of landslide on site, it is preliminarily judged that the landslide is in an unstable state as a whole under unfavorable working conditions and in a basically stable state under natural working conditions.

In recent years, heavy rainfall and continuous rainfall occur frequently, and cracks open at the trailing edge of landslide. Under the influence of continuous rainfall penetrating into slope along cracks, landslide is easy to cause overall instability failure. the overall instability and collapse of landslide will threaten the property of 3 households and 15 people at the trailing edge of landslide and passers-by and vehicles on Tongcun Highway, threatening 2 million yuan of property, with great social impact. Therefore, it is necessary and urgent to take emergency measures against the landslide.

3. Calculation of Landslide Stability

The landslide stability calculation shows that the landslide strong deformation area is basically stable in natural state and unstable in rainstorm condition. See **Table 1** for stability calculation and evaluation.

Table 1. Calculation and Evaluation Results of Landslide Stability

Serial Number	Calculation Position	Calculation Condition	Stability Coefficient	Stable State	Safety Coefficient Kst	Residual Sliding Force (kN/m)
1	1-1′ Profile	I	1.094	Basic Stability	1.20	10.2
		II	1.015	Understability	1.15	18.5
		III	1.072	Basic Stability	1.05	0

4. Project Management Scheme

4.1 Guiding Ideology

(1) Based on the geological conditions, activity characteristics and hazard status of the landslide, fully study the hazard mode and scope of the geological disaster, combine with the reconstruction planning of the disaster-stricken area, focus on key points, and carry out targeted prevention and control;

(2) Adapt measures to local conditions, emphasize practical results, and give priority to treatment projects with mature technology and economic rationality;

(3) Give priority to social and environmental benefits, so that emergency disposal temporary projects can exert the maximum comprehensive benefits.

4.2 Prevention and Control Principles

(1) The principle of putting prevention first, combining prevention and control, and eliminating hazards to promote development;

(2) The principle of adapting measures to local conditions and comprehensive management;

(3) The principle of overall planning and highlighting key points;

(4) The principle of saving investment, high efficiency and feasible technology;

(5) The principle of following the inherent characteristics and laws of the landslide.

4.3 Prevention and Control Objectives

According to the task requirements, the prevention and control objective of the emergency disposal temporary project for this landslide geological disaster is to reduce the harm of geological disasters to threatened objects, maximize the protection of the lives and

property of residents endangered and threatened by the landslide, and promote the sustainable development of social economy.

4.4 Control Level

According to the "Code for Design of Landslide Prevention and Control" (GB/T38509-2020), the landslide prevention and control level is determined as Grade III.

4.5 Overall Scheme

In view of the characteristics of this landslide, it is proposed to adopt active protective measures to protect the threatened objects at the front edge of the landslide. Specifically, a new anti-slip concrete retaining wall will be constructed at the front edge of the landslide; the cracked and damaged pavement at the rear edge of the landslide will be demolished and reconstructed, and the hollowed-out subgrade will be backfilled. These measures can provide sufficient anti-sliding resistance for the landslide and prevent subsequent rainfall from continuously infiltrating along the cracks, so as to achieve the purposes of slope support, landslide prevention and control, and protection of villagers' houses and the village-access highway.

For the road subgrade collapse outside the highway, a scheme of constructing road masonry for repair is adopted. The emergency treatment of this landslide adopts the comprehensive treatment scheme of "new anti-slip retaining wall + new drainage ditch + demolition and reconstruction of cracked roads".

References

[1] Piercy H, Nutting C. The Experiences of Parents of Children Diagnosed with Cerebral Adrenoleukodystrophy [J]. Child: Care, Health & Development, 2024, 50(1).

[2] Yang Xiaohua, Wang Dongqing, Yuan Shuai, et al. Stability analysis of expansive soil landslide based on homogenization theory and limit analysis [J]. Hydrogeology & Engineering Geology, 2024, 51(2):172.

[3] Nie Bingqi, Jia Xiangxin, Mao Yuchao, et al. Stability analysis and evaluation of a landslide based on transfer coefficient method [J]. Journal of Geotechnical and Foundation Engineering, 2024, 38(3):369-372.

[4] Zhang Liangliang, Li Shucai, Zhang Qingsong, et al. Numerical simulation of combined support effect of anti-slide piles and retaining walls for soil landslides [J]. Rock and Soil Mechanics, 2024, 45(4):1123-1132.

[5] Wang Jianguo, Liu Xiaoli, Chen Jing. Mechanism and emergency treatment technology of small-scale soil landslides induced by rainfall [J]. Journal of Engineering Geology, 2023, 31(5):1345-1353.