Mechanism Analysis of Complex Geological High Slope Landslide on Expressway

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Keywords: Expressway, High Slope, Landslide, Mechanism

Abstract: In recent years, China's transportation industry has developed rapidly. The main market of domestic expressway construction has gradually entered the western mountainous area. However, the mountainous terrain in western China is complex and the geology is bad, and the risk of high slope geological disasters will increase. Landslides are among the most common and most destructive geological disasters. Therefore, the analysis of the mechanism of the complex geological high slope landslide of the expressway is conducive to avoiding the risk of landslide risk in the preliminary design stage, taking preventive measures in the construction drawing design, and strengthening monitoring during the construction and operation phases. It plays a great role in ensuring the safety of the highway life cycle.

1. Introduction

With the continuous improvement of the living standards of the people, people are increasingly demanding safety in the process of production and life. In recent years, China's highway construction has developed rapidly, and the safety and comfort in highway construction and operation have also become the focus of attention [1-3]. The main market of expressway construction in China gradually penetrates into the western mountainous area. The route is complicated by the topography, the height difference is large, and the high slope is more and more under complex geological conditions. The analysis of the mechanism of the complex geological high slope landslide of the expressway can guide the high speed. Highway design, construction and maintenance will help to improve the safety of highway construction and operation, and will greatly promote the development of China's transportation industry [4-5]. This paper analyzes the mechanism of complex geological high slope landslide with a mountain highway landslide as an example [6].

2. What is a High Slope?

To understand what a high slope is, first understand the concept of a slope. The generalized slope refers to the geological body whose surface appears to be prone to air. It mainly includes the slope top, slope surface, slope foot and so on [7-8]. In the engineering field, the slope generally refers to the natural slope, artificial excavation or backfilling. Slope.

In the field of construction engineering, the slope of the soil slope is between 20 and 100 meters, and the slope with a height of 30 to 100 meters of stone slope has a great influence on the stability of the slope due to its slope height. Special calculations are required for slope stability, which are referred to as high slopes [9].

The common geological disasters in expressway construction include: collapse, collapse, landslide, dumping, slippery, skid, etc., which are the main geological hazards that are prone to high slopes and have serious consequences.

3. What is a Landslide?

Landslide is one of the common geological disasters. It is a geological phenomenon in which the

  DOI: 10.25236/mmmce.2019.088

rock and soil body located on the slope is affected by gravity and slides down the entire shear failure surface. According to the classification of geological disasters, landslides can be divided into four levels according to casualties, economic losses and social impacts: large landslides, large landslides, medium landslides, and small landslides.

4. Analysis of Landslide Mechanism with a Landslide Case

4.1. Introduction to construction design

During the survey and design stage of the construction drawing, the production of the slope rock formation was found to be 27°∠26°, and the strike intersected the route at a small angle. The slope was inclined to the slope, and the maximum excavation height was about 21 meters. When designing the construction drawing, the calculation parameters are: C=25KPa, Φ=15°. Two sections are selected for calculation. The maximum residual sliding force is 1736.67KN/m; 2242.19KN/m; the remaining sliding force calculated according to the calculation, The slope is designed according to the safety factor of 1.25. It is divided into two grades. The slope rate of the first and second grades is 1:075, and the frame beam + anchor joint treatment is adopted. The first and second rows are made of grouting anchors, and the rest are reinforced with 6 prestressed anchor cables. The groove is provided with 3 rows of frame anchors for pre-reinforcement. When the construction unit bolts and supports the pier, the anchor cable that has been applied suddenly fails, and the sound of the squeaking inside the slope causes the entire slope to collapse instantly.

4.2. Engineering geology

The location of the slope is generally an erosive structure with a single-sloping middle and low mountain geomorphic area. The highest point in the area is located at the top of the slope, with an altitude of more than 900 meters. The working point is located at the front of the slope and the relative cutting depth is greater than 250. The ridge is distributed in a strip-shaped strip, and the slope is dominated by a sloping slope with a slope between 25 and 35° and a large slope.

According to the results of engineering geological drilling, the strata in the area where the slope is located are mainly: Quaternary Holocene residual slope layer (Q4el+dl) silty clay, and the underlying bedrock is the Jurassic Zhonglian Shaximiao Formation (J2s) mud. Mineral sandstone and sandstone. The basic characteristics of the engineering geology of the rock formation are as follows:

The Quaternary Holistic Remnant Slope (Q4el+dl)

Silty clay: reddish brown, slightly wet, hard. Mainly distributed at the top of the slope, the thickness varies from 0 to 1 meter.

Jurassic Shaxi Temple Group (J2s)

The second layer of the Jurassic Shaximiao Formation Upper Subgroup (J2s2): thick layered purple-gray sandstone and argillaceous siltstone interbed. The bottom of the ditch is bare sandstone and no strong weathering layer. The thickness of the strong weathered layer on both sides of the bank is 1~3.5 meters.

Sandstone: purple-grey, thick-layered structure, medium-fine grain structure, the main mineral components are feldspar, quartz and cuttings. Calcium cementation. In the sandstone strong weathering zone, the rock mass is weathered and broken, the core is mostly fragmented, and the small amount is short column; the borehole is not exposed in the middle weathering zone, and the inner rock mass is relatively intact. Mainly distributed at the bottom of the gully.

Muddy siltstone: purple-red, thin layered, silty muddy structure, the main mineral composition is feldspar, cuttings, etc., calcium mud cemented, distributed on both sides of the ditch bed, the exposed thickness is 8~12 meters, partially present The lenticular distribution has water cracking characteristics, and gray-green agglomerates are visible in the layer, and the diameter of the agglomerates is about 1 to 1.5 cm. The strong weathering zone is soil-like, and the integrity of the rock mass is extremely poor. The core is mainly composed of short columns, some of which are fragmented and pancake-shaped; the rock mass in the middle weather zone is relatively complete.

4.3. Analysis of the cause of landslide

According to the investigation of the site situation, the reasons for the slope sliding of this section are as follows:

(1) The lithology of the slope stratum is the interbedded sandstone mudstone of the Jurassic Shaximiao Formation. The thick thick sandstone is located above the mudstone, and the rock formation is 27°∠26°, intersecting the line at a small angle (14°). After the slope excavation, the sandstone stratum just dug through, the front edge is empty, the slope foot stress is concentrated, and the slope after excavation is exposed to the air for a long time, affected by rainfall, rainwater infiltration, softening geotechnical parameters. Therefore, the slope slides in a smooth direction, and the cut-out is located at the front edge of the slope.

(2) Joint slopes of slope slopes, fracture occurrence L1: 321° ∠ 65°, L2: 160° ∠ 65°, after excavation of rock mass at the foot of the slope, the rock mass is unloaded, creating new cracks. After the new unloading crack develops to the L1 and L2 fractures, the rock mass collapses and collapses toward the side of the trench. The joint fissure causes the slope to collapse toward the side of the trench.

(3) Failure of frame anchorage during construction is an important cause of landslide.

5. Analysis of the Mechanism of High Slope Landslide

From the above case, the conditions of the high slope landslide are simply analyzed:

(1) Slope rock type: Slope is the material basis of landslide. All slopes are likely to have landslides. For easily weathered rock masses, or rock masses with poor shear resistance, loose rock masses, rock masses that are prone to change under water erosion, such as loose Overburdens, bedding layers, shale, yellow maps, coal seams, mudstones, and slopes with weak interlayers are prone to landslides.

(2) Geological structure: The slope body only has a sliding surface, that is to say, when the rock and the soil body are cut into a discontinuous separation state at the structural surface, the possibility of sliding is obtained. The structural surface of the cut rock and soil is the sliding surface, which provides conditions for the water flow such as rainwater to enter the slope body. The rain erosion will further weaken the shear resistance of the structural surface. Therefore, for the joints, stratification, and the existence of cracks, the slope is most likely to slip.

(3) Topography: Certain geomorphological conditions are also necessary for slope sliding. Slopes close to the water source area, open high slopes such as roads and railways, when the slope is greater than 10 degrees, less than 45 degrees, the slope is steep and steep, and the upper part is ring-shaped.

(4) Hydrogeology: Groundwater is an important factor in the formation of landslides. The erosion of water causes the strength of rock and soil to decrease, and the water has water pressure in the slope. The movement of water in the slope generates hydrodynamic pressure, increases the density of the water slope, and produces upward buoyancy on the slope. The shear resistance of the structural surface is reduced, and the slope is more prone to slippage.

(5) External factors such as earthquakes, heavy rain and erosion of surface water and erosion will cause instability of slopes and slopes; during construction, excavation is not carried out according to design and specifications, pile top loading, artificial footing of slopes, illegal blasting, etc. All other factors can cause the sliding of the structural surface and the occurrence of landslide.

6. Conclusion

Taking a highway as a landslide as an example, this paper briefly analyzes the cause of landslide and extends it to the condition analysis of landslide. High-slope landslides are common geological disasters in the construction of expressway maintenance, which are structurally destructive and cause serious hidden dangers to production and operation safety. Through the analysis of this paper, the landslide can be prevented in advance from the landslide mechanism and landslide conditions, avoiding after-the-fact remediation, which not only increases the cost but also bears huge security risks. This move has positive driving effect and social effect on the development of expressway.

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