Motion and deformation mechanism of landslides triggered by impoundment in Three Gorges

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The Three Gorges Dam constructed on the Yangtze River in China is one of the largest hydro-electricity projects in the world. The designed final highest water level is 175 m, which is planned to be reached at 2009. When the dam was partially completed, in June 2003, the water level (elevation) was raised to 135 m from 90 m, and in October 2006, from 135 m to 156 m, to produce hydroelectric power. As soon as the first impoundment was conducted at the beginning of June 2003, deformation and displacement was observed in the ancient landslides in the water reservoir area. A case study on the Qianjiangping landslide (Fig. 1) and monitoring on Shuping landslide (Fig. 2) were introduced in this report.

▲ : area with long sliding distance;
▲ : area with relatively shorter sliding distance;
QJP-T1: Investigation tunnel

Fig. 1 View of the Qianjiangping landslide from the opposite bank (a: Taken by Y.M. Zhang, July 15, 2003)

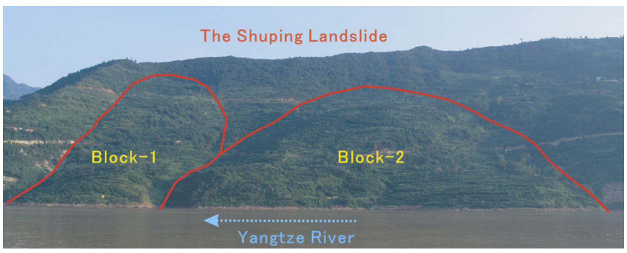

Fig.2 Shuping landslide consisting of two blocks at the main stream of the Three Gorges Water Reservoir

Motion mechanism of the Qianjiangping landslide

Two samples (yellow layer and black layer) were taken from the sliding zone of the Qianjiangping landslide and two types ring shear tests (Shear stress controlled shear test to simulate the landslide initiation, and shear speed controlled test to clarify the shear rate effect) were conducted to clarify the rapid motion mechanism of the landslide. The two samples behaved differently. For the black sample, shear resistance decreased quickly to a low residual shear resistance when the sample failed. While, for the yellow sample, shear resistance just showed a very small decrease, and recovered soon. It can be concluded that only when the shearing occurred in the black layer, could the landslide have a rapid motion. The reason for the different behavior is attributed to the different soil properties.

Displacement monitoring in the Shuping landslide

The deformation of the Shuping landslide became active after the first impoundment of the reservoir. A monitoring system consisting of extensometers was established in 2004. The two-year monitoring shows a tendency of landslide deformation caused by water level changes and the deformation feature of the landslide. Both of water level increase and decrease caused deformation rate changes. However, the influence from water level decreasing seems larger than that caused by water level increasing.

A new monitoring system with 5 pore-pressure transducers, 5 flexible extensometers, 4 tilt meters, 2 Pipe strain gauges, and 23 short-span extensometers, which was established in 2006 will also be introduced.