Countermeasures for large-scale landslide dams caused by Typhoon No. 12 in September 2011

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1. Introduction

A great number of large-scale debris disasters such as deep-seated landslides were caused by the heavy rainfall triggered by Typhoon No. 12 mainly in Nara and Wakayama Prefectures of Kii Peninsula in September, with the result that these places were seriously damaged. Landslide dam occurred at 17 positions. In five of these points where the damage was particularly serious, countermeasures are currently being taken by the Kii Mountain District Sabo Office under the direct control of the Government. At present, the emergency work of installing temporary overflow channel for ensuring provisional safety has been terminated. Full-scale measures such as construction and improvement of the sabo dam and overflow channel are currently being taken. The following reports the progress in working out the measures.

2. Implementation of emergency work

After formation of the above-mentioned landslide dams, emergency work was started at five landslide dams in Akadani area, Nagatono area, Kuridaida area and Kitamata area of Nara Prefecture, and Iya area of Wakayama Prefecture in a project under the direct control of the Government during the period from September to October 2011. The aim of the emergency work was to build temporary overflow channels to accommodate any flood on the level of 2-year probability of exceedance before the rainy season in the following year so as to prevent damage by overtopping and resulting erosion of the landslide dams. Almost all measures were completed by mid-June 2012.

3. Status of damages at the relevant positions during the period of deluge

In the Akadani area, the deep-seated landslide slope adjacent to the temporary overflow channel was again subjected to collapse due to the Typhoon No. 4 of June 19, 2012, with the result that a huge amount of debris was discharged into the temporary overflow channel, and was deposited over the entire area of the temporary overflow channel whose construction had almost been completed. This exemplifies the likelihood of disaster if facilities with an open water channel are built as countermeasures immediately below an unstable slope; the maintenance of such facilities will be made difficult by the inflow and deposition of debris. Meanwhile, water is discharged from the flood reservoir through an underground culvert below the temporary overflow channel bottom. This suggests that the installation of a culvert may be effective for a landslide dam adjacent to an unstable slope when countermeasures are taken.

In the Kuridaira area with an about 100-meter high landslide dam, the landslide dam was subjected to a large-scale erosion at the time of rainfall during the Typhoon No. 17 of September 30, 2012, and two-thirds of the temporary overflow channel with an overall length of 576 m was discharged (**Photo 1**). This is considered to have been caused by the following: Scouring was caused at the terminal of the temporary overflow channel by the running water flowing down from the temporary overflow channel with a head of 94 meters, and this gave an overall impact to the landslide dam. This example shows that when an overflow channel is installed in a landslide dam with a great difference in hydrostatic head, it is important to build a sabo dam at the terminus of the overflow channel simultaneously with the overflow channel for the purpose of scour protection.

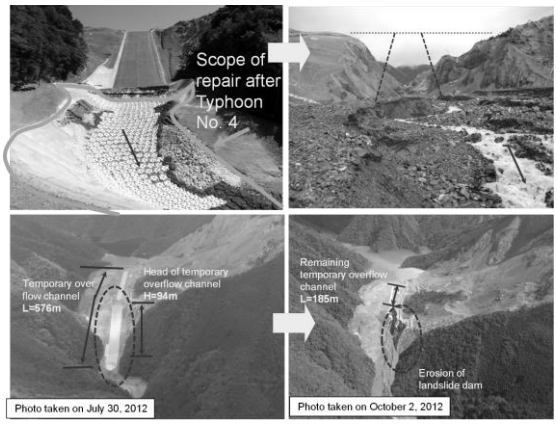

Photo 1 Comparison of temporary overflow channel before and after Typhoon No. 17 of September 2012

4. Working out the policy of the countermeasures for landslide dam sites

In implementing full-fledged measures following the emergency work for the large-scale landslide dam for which no countermeasures have ever been taken, we set up a Committee consisting of academics on sediment control, geographic features and rivers. The policy for the countermeasures was worked out under the guidance and instruction of the Committee. The following describes the major policies:

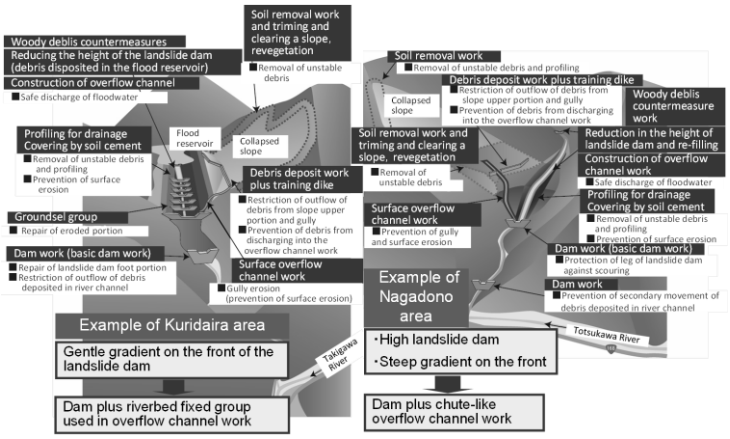

Fig. 1 Countermeasure example (Kuridaira and Nagatono area)

- To alleviate the impact of water discharged from the flooding reservoir, reduce the elevation of the overflow, and back-fill the flooding reservoir with the debris having been excavated. Make positive use of soil cement formed by agitating and mixing the local debris and cement for the reason of excellent workability and lower costs.
- Install an overflow channel for safe discharge of flood (100-year probability of exceedance) on a planned scale. In this case, the overflow channel should be designed in a chute structure if the landslide dam is high and the slope downstream of the landslide dam is steep, and if the slope downstream of the landslide dam is less steep of the height of landslide dam is low, a groundsel group should be installed.
- The terminal of the slope downstream of the landslide dam should be provided with a sabo dam constituting a core of the countermeasures at an earliest possible chance to ensure prevention of scouring at the terminal of the overflow channel and reduction in the speed of the water discharged through the overflow channel.

Fig. 1 illustrates the examples of countermeasures based on the above-mentioned policies. In conformance to these policies, detailed designs are being worked out and countermeasures are being implemented in each area.

Keywords: landslide dam, countermeasures plan, Sabo facilities