

Application of SABO Technology to Control Debris Flow and Landslides: Experience from Mugling-Narayanghat Highway Disaster

Nepal

The Mugling-Narayanghat Highway is an important section of the national highway network because it links the capital, Kathmandu, to Terai and India. The highway is 36 km long and runs along the left bank of the Trisuli River, a major tributary of the Narayani River Basin. The road corridor passes through fragile geo-physical formations of the Lesser Himalayan Zone and Siwalik Zone and crosses about 30 streams and rivulets. Similarly, this section is intersected by several tectonic zones that range in size from regional to local. The elevation of the road corridor area ranges from 200 m to 900 m above mean sea level. The area has a sub-tropical climate and evergreen forests. In Winter temperatures range from 6 to 25 degrees Celsius, while it is 25 to 40 degrees in summer. The average annual rainfall in the area is about 2650 mm.

With a cloudburst rainfall of 446 mm in 24 hours on 31 July 2003, numerous landslides, debris flows, slope failures, and rockfalls were triggered along the Mugling-Narayanghat road corridor. This disaster not only blocked the highway for several weeks but also damaged two bridges, nine culverts, 8.6 km of road pavement, 494 m of retaining walls, and 1480 m of embankment. Emergency measures were taken to open the road by clearing about 200,000 m³ of debris coming from hillsides and streams crossing the highway. However, the highway was far from being fully operational, causing acute shortages of food and fuel in the capital city that affected 2 million people. Realizing the seriousness of the problem and its future socio-economic impact on the nation, the Department of Water-Induced Disaster Prevention (DWIDP) in close coordination with the Department of Roads (DOR) took the initiative towards solving this problem before it became larger. This initiative culminated in to a three-year project known as the “Mugling-Narayanghat Water-Induced Disaster Prevention Project (MNWIDPP),” which received grant assistance from the Government of Japan.

The main objective of the project is to mitigate and prevent water-induced disasters along the Mugling-Narayanghat Highway and to secure the safety of highway traffic. With the technical assistance of the Japan International Cooperation Agency (JICA), the Project has identified 13 major disaster sites, two of which are outside the road corridor. One of these is the Ruwa Khola debris flow near the Marshyangdi Hydropower Station in Tanahun district, and the other is the landslide near Manakamana Temple in Gorkha district. With a detailed survey and investigation of identified disaster sites, the Project has focused on Sabo technology for debris flow control and slope stabilization. A series of Sabo dams, check dams, and river toe walls and gully stabilization works, landslide protection works and bioengineering works are the main structural works designed to cope with debris flow and slope failure. The major countermeasure works of this project are described as follows.

Sabo dams at Ruwa Khola: To safeguard the Marsyangdi Power Station and the highway bridge, two concrete Sabo dams were constructed at Ruwa Khola at chainage points 0+275 and 0+460. These Sabo dams performed very well during the monsoon season and protected the power station and the Prithivi Highway bridge.



Sabo dams at Khahare Khola: Two Sabo dams were successfully completed at Khahare Khola at chainage points 0+220 and 0+310. These Sabo dams functioned well during the floods of

Photo 1: Sabo dam at Ruwa Khola at Ch 0+460

2006 as floodwaters carrying debris flowed over these structures without inflicting any damage on highway bridges and nearby houses.

Check dams at Gaighat Khola: A series of gabion check dams (10 check dams and 5 retaining walls) was constructed at Gaighat Khola at Ch 18+940 km. To prevent downstream scouring, a gabion-launching apron with a plain concrete capping was designed. Bio-engineering works such as bolster construction; slope trimming; and bamboo, tree and grass plantation were also carried out, along with structural countermeasure works. The performance of these check dams has been satisfactory in reducing stream gradients and stabilizing slopes.

The Project is scheduled to be completed by July 2008 and the countermeasure works completed to date have demonstrated satisfactory performance in minimizing road damage in the rainy season. With the implementation of the project, the frequency of road blockages due to debris flow, landslides, or by slope failure has been significantly reduced.



Photo 2: Sabo dam at Khahare Khola at Ch 0+220



Photo 3: Check dams at Gaighat Khola at Ch 18+490 km

- Background

Mugling-Narayanghat Highway is the bottleneck section of the national highway network of Nepal, and it was severely damaged by intense rainfall on 31 July 2003. The highway was blocked for several days due to the damage of two bridges, nine culverts, 8.6 km of road pavement, 494 m of retaining walls, and 1480 m of embankment. The DWIDP took the initiative to retrofit this road section with the grant assistance from the Government of Japan. With the technical assistance of JICA, the Project has focused on Sabo technology to cope with 13 major disaster sites that have been identified.

- Objective

The main objective of the Project is to mitigate and prevent water-induced disaster along this section of the road and to secure the safety of highway traffic.

Time Frame: Initially planned as 2004-2007, later extended up to 2008.

- Activities undertaken

Construction of Sabo dams, check dams, toe protection retaining walls, and bioengineering works in 13 disaster sites, including Ruwa Khola, Khahare Khola, Jugedi Khola and Das Khola.

- Major achievements

With the implementation of Sabo technology for controlling debris flow and landslides, fewer number of water-induced disasters have been observed in monsoon season. In general, the project has had a significant positive impact on highway traffic safety.

- Total budget

NRs 302.5 million (US\$4.76 million)

- Contact details

Basistha Raj Adhikari, Senior Divisional Engineer,
Department of Water Induced Disaster Prevention, Pulchowk, Lalitpur.
Phone: +9771 5535502, +9771 5535503; Fax: +9771 5523528
Email: dwidp@ntc.net.np, basistha@wlink.com.np