

CASE HISTORY

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LANDSLIDES MITIGATION MEASURES AT KM 63 NEAR CHAMBA TUNNEL ON RISHIKESH - DHARASU ROAD (NH-34), UTTARAKHAND UTTARAKHAND, INDIA



At the Heart of GeoHazard Mitigation Activity

Rockfall Protection

Client:	Products used :
BORDER ROADS ORGANIZATION	• DOUBLE TWISTED WIRE MESH • TECHRHOMBUS HRC • TECHANCHOR
Main contractor:	
CHAUDHARY CONSTRUCTION CO. PVT. LTD.	
Manufacturer & Supplier:	Year of construction:
TECHFAB (INDIA) INDUSTRIES LTD.	2023

Project brief & Problem Description:

Landslides, being critical in nature, are very common in hilly region and is influenced by several parameters. The frequency of landslides is increasing nowadays, due to more and more human interventions. The Himalayan region is more vulnerable due to its dynamic nature, complex geology, young rock mass, heavy rainfall, and climate change. Heavy rainfall creates a great problem in various parts of Himalayan region in the form of landslides and subsidence, directly impacting the traffic on the roads.

The economically and strategically important project i.e., Chardham Highway Development Project was announced to improve the connectivity of four holy Hindu shrines, namely, Kedarnath, Badrinath, Gangotri and Yamnotri. In this project, upgradation and development of the roads will be carried out by connecting all four dhams. During widening of roads to two lanes, some areas are prone to slide due to geology, geomorphology, rainfall, and other reasons. The slide Location is located about 2.3 km after North Tunnel Portal, Chamba, Chamba to Dharasu Highway (NH-34) between 63.310KM to 63.390 KM. The slide zone is exposed and adjacent area is covered by low to moderate vegetation. The angle of the slope ranges from 50⁰-70⁰ and a seasonal nala is present on western side of the slide zone and passing all along the slope towards east direction.

Project Challenges:

- During the widening of existing NH-34, the stability of slope mass has been disturbed by toe cutting.
- The slope has been cut at toe portion and the steep cut slope is standing at height of about 40-50 m without any intermediate benches.
- The area is prone to heavy rainfall and seismic activity falling under Seismic Zone-V.
- Closely spaced joints which are dipping opposite to the slope direction at the top portion may cause toppling failure due to steep cutting of slope.



Slided Slope Mass



Slope Condition



Source: Google Earth

Slide Location (Before Road Widening, 2018)



Source: Google Earth

Slide Location (After Road Widening, 2021)

Solution Proposed:

Slope stabilization measures are required to be provided on the hill side slope. Several slope stabilization measures which can be adopted are Earth Works (excavations near crown of landslide and filling near the toe of the landslide), Buttress Fills, Retaining Walls (Gravity Walls, Reinforced soil walls/slope), rigid fascia/flexible fascia along with Soil Nailing/ Ground Anchors, Reinforcing Piles, Gabion wall etc. Based on site condition, the following solutions were proposed:

- Loose scaling/trimming in isolated patches of unstable blocks or steep profile as per site conditions.
- Due to space restrictions on the hillside and valley side, Self-Drilling Anchors (SDA) of 6 m length spaced at 2.5 m c/c in both directions for maximum height of 47.5 m above existing wall is proposed. The soil anchors shall function as passive mitigation measures to address global instability.
- Considering the terrain and location of project, it has been proposed to provide the flexible fascia, i.e., high tensile steel wire mesh (TechRhombus as a Primary mesh and Double twisted wire mesh as a secondary mesh) for the exposed slope surface.



Proposed Solution on the Slope

Execution process at the site :

- The area is excavated/scaled up to the levels and slope as per the drawings.
- Marking is done on slope at the set locations and drilling was executed for installation of SDA.
- The anchorage system is installed with rotary percussive drilling and continuous grouting to cause minimum ground modification and disturbance possible.
- To contain grout, the typical inclination of drill hole is kept at around 10 degrees to horizontal inclining upwards.
- Grout Injection is carried out through hollow steel bar. Injection mixture flows through the holes at the sacrificial drill bit and automatically stabilizes the drilled hole.
- The rolls of DT Mesh are transported to the top of the slope (crane, winch or rope way system may be used) and the rolls are aligned on the upper edge.
- The rolls are opened and extended on the top for the designed run out length and are laid into the trenches over the anchors.
- The adjacent mesh lapping can be done by looping or ring system.
- Installation of TechRhombus Mesh with High Resistant Clip (HRC) to be done.
- TechRhombus consists of top and bottom cables which are composed by steel cables galvanized with a Zn-Al alloy galvanization.
- Meshes shall be rolled down till the required length and the base plates shall be fixed over the anchors and mesh and tightened
- Periodic maintenance shall be carried out after each rockfall event by clearing off the debris collected within the draped mesh.
- All connections shall be checked periodically (approx. every 6 months).



Installation works in progress

**Completed Structure**

Conclusion:

Under this project, stabilization measures such as scaling of overhang rock cliffs, application of high tensile rolled cable net ,DT Mesh along with SDA have been envisaged without affecting existing structures, environment, and forest within the area. The protection is serving as desired by the authority. After stabilizing the affected vulnerable stretch of this road, uninterrupted traffic flow would certainly augment the regular movement of locals & by passers for their daily requirements in the region, which will naturally upgrade the economic conditions of the people belonging to the entire area.

For further details kindly contact :

TechFab India Industries Ltd.

46 & 47, Maker Chambers VI, Nariman Point, Mumbai - 400021

Tel: + 91- 22 - 2287 6224 / 6225

Email : info@techfabindia.com

Website : www.techfabindia.com