

# ROCKFALL MITIGATION MEASURES ON HILLSIDE - GULABKOTI, UTTARAKHAND

## ALONG NH-58, CHAMOLI DISTRICT, UTTARAKHAND, INDIA

### Surface Strengthening and Support

#### Problem

Gulabkoti village is located in Chamoli district of Uttarakhand state, India. It is 18-km away from Joshimath town. Due to presence of highly jointed and fractured rock, the hill-slopes are prone to rock-fall. The site studied is along NH-58 on the banks of River Alaknanda. The exposed slope is formed with weathered rock strata that were subjected to rainfall during the monsoon seasons. These rainfall infiltrations when accompanied by the erosion factors, critical joints and the steepness, trigger the rock detachment which made the slope more susceptible to rockfall that affects the movement of traffic along this route. Also, the existing water streams have also contributed to weathering of rock mass and since this location falls in seismic zone V, the seismic forces is also one of the destabilizing factor. Moreover, overhangs also existed on the slope making the site very critical.

#### Solution

The selection of system had to be resilient to critical joints, road widening requirement, subsurface water, high seismic forces, and steep topography. In order to counter the steepness of valley slope for widening of road, the feasible option was partly cutting on hill side and partly widening on valley side. The re-profiling of the slope has been followed by installation of simple /secured drapery system with high resistance Steelgrid HR 50 mesh and nails to guide or contain the rock detachments. The continuously threaded anchors (CTA) contribute to provide surficial protection and the mesh contains the debris or the rock blocks that might move between the anchors in secured drapery system. In simple drapery system, the mesh is secured at top and bottom with CTA and the mesh guides the detachments to the toe. The drapery systems are considered passive, because both mesh and anchors start to develop their resistance when the rock blocks start to move. To channelize the surface runoff, effective drainage measures like sub surface drain pipes (perforated PVC pipes), basin and road side drains are also provided. Additional measures such as valley side retention is adopted separately.

**Client:** NATIONAL HIGHWAYS & INFRASTRUCTURE DEVELOPMENT CORPORATION LTD.(NHIDCL)

**Designer / Consultant:** MAGOT ENGINEERING CONSULTANTS PVT. LTD.

**Contractor:** RG BUILDWELL ENGINEERING LTD.

#### Products used (Qty.)

- Steelgrid HR	9901 Sq.m
- Anchor Bar	CTA - 25/32mm dia -4425 RM

**Date of construction:** 01/2018 - 10/2021



Figure-1 Satellite image of Gulabkoti site



Figure-2 Initial Site condition



Figure-3 Reprofilng activities in progress



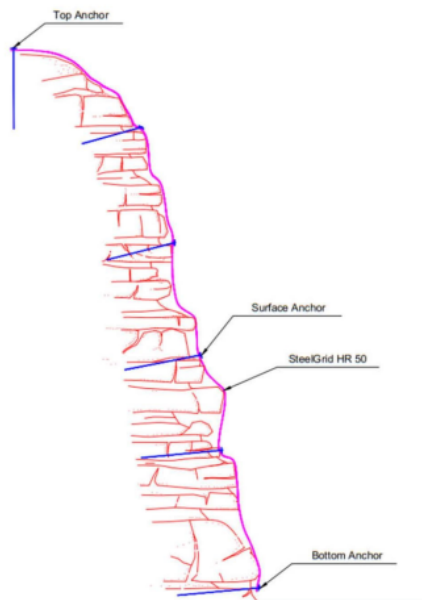
Figure-4 Site condition during installation (Oct 2021)



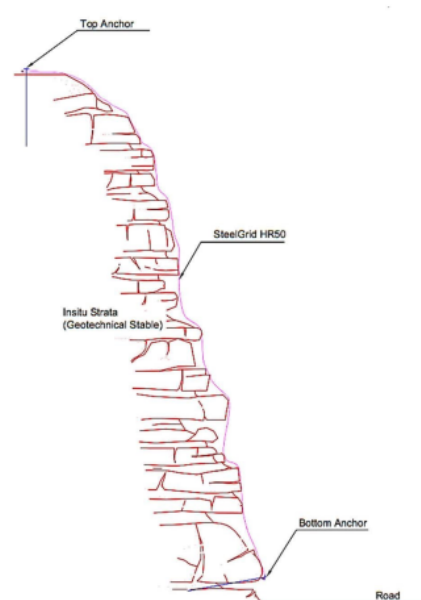
Figure-5 Improved site condition(July 2022)



Figure-6 Improved site condition( 2022)



TYPICAL CROSS SECTION OF SECURED DRAPERY



TYPICAL CROSS SECTION OF SIMPLE DRAPERY

## TYPICAL SOLUTION SCHEMES

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