

# **Geologists for Sustainable Development**

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Buildings can certainly be constructed in the hills without slope modification utilising the natural gradient of the slope, thereby curtailing the cost of site development and also managing the menace of debris disposal besides making the end product aesthetically pleasing and utilitarian.

## **Roads in mountainous terrain**

Roads cannot however be constructed without preparing a continuous flat surface along the hill slope. This flat surface however facilitates accumulation and infiltration of rainwater that is otherwise naturally disposed along the hill slope.

This at the same time changes the angle of repose of the slope-forming materials thereby inducing instability in the material on the upslope side of the flat surface so created.

Excavation of the hill slope to create a flat surface produces loose debris and rock mass. Reckless disposal of this material often results in environmental degradation, as well as the enhanced pace of siltation of rivers and reservoirs besides inducing slope instability.

All road construction initiatives in the hills should therefore accompany provisions of (i) rainwater disposal from the flat surface, (ii) retaining structure for supporting the excavated hill slope, and (iii) disposal of excavated debris.

In case these measures are not implemented road construction is to destabilise the hill slope, and aggravate the menace of landslides.

## **Roads and landslides**

Be it Kaliyasaur or Lambagar - most chronic landslides in the region are located in close proximity of the roads. A recent study based on field investigation of 510 landslides identified in upper catchment of Alaknanda river establishes 42% to be located in close proximity of the roads, i.e. within 50 meters.

Absolute number of landslides as also landslide density are both shown to exhibit strong positive correlation with sharply decreasing trend with increase in the distance from the road.

Based upon this the authors have inferred landslide occurrence to be highly influenced by the spatial distribution of roads and fast depleting probability of getting affected by landslides with increasing distance from the road.

### **Dharchula landslide - 2022**

Landslide incidence around Dharchula in Pithoragarh district in the evening hours of July 29, 2022 has once again brought forth this issue wherein a large population is threatened by slope instability along Dharchula – Tawaghat – Lipulekh motor road that is being widened presently.

According to the media reports the area started to exhibit signs of distress almost three years back when road widening work was initiated by Border Roads Organisation (BRO).

The upper reaches reportedly witnessed fissures, ground subsidence and landslides during the monsoon period of 2021, and the resulting flow of debris caused damage and disrupted normal life in the Malli Bazar area of Dharchula.

It is also put forth in the reports that the people had perceived the threat posed to the downslope habitation from the boulders embedded in the slope material, and had approached the BRO authorities for disposing these.

The present incidence is thus attributed by media to the inaction of BRO.

### **Perceived risk**

As evident from the photographs and videos on social media, it is a case of reactivation of old landslide zone and rolling down of large boulders embedded in the slope material has caused damage to the habitation on the downslope area.

People might have suggested safe disposal of the embedded boulders but then doing so would have severely destabilised the slope as these boulders are integral part of the debris and provide stability to the finer constituents. Geologists would have certainly not agreed to this suggestion.

But then, other stabilisation and mitigation measures could certainly be put in place. Affected hill slope seems to be covered with thick pile of colluvium

material with huge imbedded boulders, and with the area at the toe of the landslide being densely populated, the risk is high.

The entire area has thus rightly been vacated by the administration, and the people have been shifted to temporary shelters.

### **Precautions and way forward**

Disturbing the toe is to further destabilise the slope material, and cause damage to the structures.

Slided debris along with boulders accumulated at the toe of the slide in the proximity of the habitation should therefore not be disturbed unless appropriate measures for restraining the material on the upper slopes are put in place.

With the connectivity of Byans, Chaundas and Darma valleys disrupted by the landslide, administration as also BRO are to face pressure for undertaking measures for making the road fit for vehicular traffic. It however needs to be appreciated that the road bench is acting as a natural restraint for the destabilised upslope material, and debris clearance from the road is to destabilise the upslope material, and aggravate the problem.

It is therefore warranted that measures for restraining upslope material precede any attempt to clear the debris from the road. Needless to put forth that the road in question is strategically important as it connects forward posts along Sino-India border. It at the same time is a lifeline for the habitations of Byans, Chaundas and Darma valleys.

The measures for the restoration of the road cannot therefore be delayed.

It is therefore required to promptly muster professional geological advice for planning, designing and implementing both short and long term restoration and mitigation measures.

### **Old slide zones**

The present motor road induced landslide around Dharchula brings forth an important issue related to infrastructure development initiatives in the hills.

Though often considered a bane, landslide is an important landform modifying geomorphic process that facilitates soil formation and promotes vegetal growth in the hills.

It needs to be acknowledged that large proportion of the slopes in the hills are covered with debris generated in previous landslide incidences, and the same has been stabilised with the passage of time.

Though stabilised, the old slide zones are in critical state of equilibrium, and can result in fresh landslides if provoked by anthropogenic activities or natural denudation forces.

It is therefore necessary to identify old slide zones with the help of geologists, and avoid these to the extent possible while undertaking developmental initiatives including road construction.

Appropriate legislative and regulatory measures can also be invoked for honouring privacy of the old slide zones. Road widening exercise often destabilises old slide material that has attained angle of repose over the passage of time.

It is therefore required that geological advice be invariably sought before undertaking any slope modification exercise in the hills.

### **Landslide - A geological problem**

Despite often facing slope instability related issues, it is an irony that most infrastructure projects in the hills are being planned and executed by the engineering fraternity without due consultation with the geologists, particularly during the planning and designing stage.

Geological advice is generally sought only when slope instability becomes chronic or threatens human population or major infrastructure. Moreover, not appreciating the basic precept that every single landslide has a unique character of its own and solution applicable to one cannot be replicated to the other, geologists are expected to provide quick fix solutions.

It needs to be understood that geologists do not have a magic wand to instantly stop or solve slope instability issues. Moreover slope stabilisation is a long drawn process and geological inputs can only hasten it.

### **Geologists for sustainable development**

If sincerely seeking sustainable and cost effective developmental initiatives in the mountainous terrain politicians, administrators and planners have to be amply clear on two highly pertinent issues.

- Firstly, landslide is a geological problem and not an engineering problem  
- as is commonly perceived and understood by them.
- Secondly, geological inputs alone can ensure sustainability of developmental initiatives in the hilly regions.

Hope geological advice is invariably sought and adhered to during conceptualisation, planning, design and implementation of all developmental initiatives - particularly in the hills - for making development sustainable, region prosperous, and masses safe, happy, cheerful and content.