

# Preventive Measures for Landslide Disaster: A Case Study of Shimla District

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## ABSTRACT

The Himalayas experienced different types of disasters. The landslide disaster has caused irreparable loss to the human life and property of Himalayan people. Mostly landslide disaster is caused due to natural causes but the frequency of landslide has been accelerated by human interference with the natural environment. The present study deals with the mitigation measures for landslide disaster in Shimla district in Himachal Pradesh. During recent times with the increase in human activities in the district, these hazards have become more anthropogenic rather than remain simply natural and the study tries to identify mitigation measures taken by the government and local people. The study is primarily based on field work accompanied by the secondary data.

**Key words :** Himalaya, Disaster, Hazards, Landslides, Anthropogenic.

## Introduction

Landslide is a rapid form of mass-movements. The term has traditionally been used to cover falling and flowing types of earth materials, in addition to those moving by sliding. However, landslides differ from another family of gravity movements, those referred to as subsidence, collapse and settlement. Such terms denote vertical change in the ground surface, whereas landslides are a down an out motion. Landslide occurs when the sum of the resisting down slope movement are exceeded by the sum of those creating it. In the present study the term landslide is used to describe both the process of rapid down slope movement of earth materials, as well as the topographic landforms that result from such action.

## Study Area

The present study is based on the Himalayan mountainous region of Himachal Pradesh where Shimla

district is selected for studying the occurrences of landslides.

Shimla district is located in the south-west border of the Himachal Pradesh. It is bounded by Kinnaur district in the north-east, by Kullu and Mandi districts in the north-west and by Solan and Sirmour district in the south-west. The district extends from 30° 45' north to 31° 44' north latitudes and from 77° 0' east to 78° 19' east longitudes covering an area of 5131 square kilometers.

The Shimla district selected for present study is highly susceptible to the occurrences of landslides of various types. The anthropogenic disturbances have heightened the natural processes to act to the detriment of geo-ecology. The end result is the increased number of a variety of landslides.

## Objectives

The study of the paper is based on the following objectives:-

1. To investigate mitigation measures taken by the government to mitigate landslide disaster in the Shimla district.
2. To suggest some mitigation measure.

## Materials and Methods

In general, the present study is based on morphometric analysis, photographic work and field survey. The study is almost entirely based on primary data collected by personal survey in the field. Different landslide sites in the Shimla district are visited to study these disasters. Another method of primary data collection in Shimla district consists of field mapping of the existing landslide sites.

## Analysis and Interpretation

The landslide disaster is common phenomena in the Himalayas. It has affected human being of the Himalayas adversely. Though landslide disaster is a natural phenomenon, its prevention is very difficult. However, man by planning his activities can reduce the impact of landslides to some extent. The man has discovered some planned techniques to reduce the impact of landslides by taking various means of preventive measures.

## Evaluation of Preventive Measures

The followings are the preventive measures taken by the government to minimized landslide hazards in the Shimla district.

### Bamboo Check Dams

This method is adopted mainly to minimize the debris slide. Various human construction activities such as construction of roads, dams and buildings generate a large amount of unconsolidated regolith which is deposited by the road sides or on the mountain slopes. During rains these unconsolidated colluviums get saturated and after attaining motion, cause destruction to nature and human property such as houses, agricultural fields, vegetation, telephone and electricity poles.

Bamboo Check dam consists of bamboo stakes or stakes of self-regenerating branches of trees like *ficus cunea*, *poplar*, *willows* and *erithrina* species, *phragmites koka*, *lamea grandis*, *ipomea carnea* and *arundodonox*; cuttings wherever available ( Natarajan, T.K. and Gupta, S.C. 1980).

Bamboo Check Dam technique is adopted by the people near Bishop Cotton School, towards Khalini

in Shimla town (Plate-1). When bamboos will start growing, their roots will keep soil bounded and this will minimize the slide of colluvium. Bamboo Check Dam Technique was use near Bishop Cotton School.

## Retaining Structure Technologies

Retaining structures are the most wide spread structural measure adopted in the treatment of the landslides in the study area. They are the most effective preventive measure taken by government in the Shimla district. Retaining structures are more visible along the National Highway-22 and state highways, within and around the main Shimla town.

A variety of retaining structures have been witnessed by the researcher in the Shimla district during field investigations.

### a. Toe Wall

A most commonly adopted structural measure in the study district is the toe wall. A toe wall is made up of concrete and stones. It is constructed towards the hillside slope to reduce and minimize landslides. In some places where the height of the slide is less toe walls are constructed in a single step wall. In some places where the slope height is very high terraced walls are built up. One such toe wall is being observed below Vidhan Sabha (Plate-2). It was observed during the field survey that construction of toe wall in Kufri area has also been adopted to minimize the landslide.

### b. Gabion or Wire Crate Structure

Gabion or wire crate structures are emerging within the study district to minimize the impact of landslides. These types of structures are mainly in use along the national highway - 22. Stones are filled in a systematic order in a net made up of iron wires, known as Gabion or Wire Crate Structures. Wire crate structures are used at those places where the frequency of landslides is very high mainly due to heavy rainfall. The structures made up of stones pile within wire net are permeable and flexible. In Vihar village in Khalini in Shimla such wire crate wall was constructed to stabilize the landslides (Plate-3). Another example of four stepped wire crate structure is seen in the Khalini area (Shimla) along the road (Plate-4).

## Retaining Walls

In the Shimla district retaining walls made up of concrete and cemented material are the widest

spread structural measures adopted by the government and the local residents in the treatment of the landslides in the district. The holes are kept at regular interval in a wall to drain out water, to reduce the chance of water pressure building up in the slope. These holes are known as Weep Holes. A huge retaining wall has also been constructed near petrol pump in Chailla to acquire the required width of the road and to support the unconsolidated material coming down due to erosion by the Giri river. A number of such walls are more visible in Narkanda, Theog, Charabra, Fagu, Kufri, Sainj, Kotkhai and Kumarsain.



**Plate 1.** Bamboos are grown to stabilize debris slide near Bishop Cotton School



**Plate 2.** Toe Wall under Vidhan Sabha



**Plate 3.** Toe Wall in Kufri



**Plate 4.** Wire Crate structure under construction in Khalini.

### Counterfort Retaining Walls

Counterfort retaining wall is an another method to mitigate the occurrence of landslides. Counterfort retaining wall is made up of cement, sand, stones and iron rods. Counterfort retaining wall constitutes a vertical slab, counterfort and a heel. Vertical slab lies in the front portion of the wall. Counterforts are the supporting walls attached at the back of the vertical slab at right angle. Heel forms the base of the counterfort retaining wall. On the other hand, the longer portion on which vertical slab is standing



vertically is called toe (Fig.-1 & Plate-5).

### Drainage Related Measure

The surface water acts as a triggering factor for the occurrence of landslides. In Shimla district the impact of surface water is more prominent after heavy rainfall especially during monsoon season. In the study area water has been diverted towards valley side by making horizontal cemented paved channels at the base of retaining walls and breast walls. The cemented paved channels have been seen along the national highway-22 and in the developed inhabited areas such as Kufri, Theog, Narkanda, Rohru, Shimla and Jubbal (Plate-6).

The Public Works Department has come up with a technique called *Hard Roll Wire* structure to stabilize the slope of the study area. This is similar to the wire crate structures but difference is that the thickness of the wire of *Hard Roll Wire* is 6mm and it is rust free. In this, a bucket shaped rectangular wired structure is being prepared which is filled up by stones within it systematically (Plate-7 & 8). This structure easily allows the emission of water out from the wall received during rainfall and restricts the hydrostatic water pressure which leads to the occurrences of landslides.

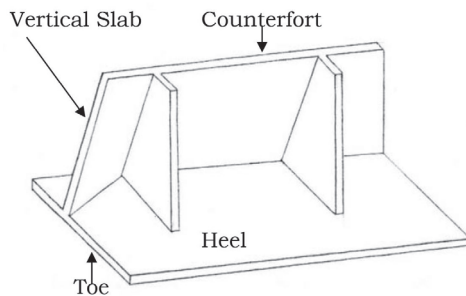


Fig. 1. Counterfort Retaining Wall



Plate 5. A Construction of Counterfort Retaining Wall in Khalini



Plate 6. A huge cemented pipe to divert the surface water in Khalini



Plate 7. Hard Roll Wire structure near the Lift.



Plate 8. An overview of the Hard Roll wire structure.

### Conclusion

The activities of landslide is natural phenomenon in the study area. It is not possible to stop it entirely but some preventive measure can reduce the impact of landslides in the Shimla District.

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