

## Landslide

→ Landslides are relatively the downslope movements of soils and rocks which takes place characteristically on one or more discrete bounding slip surfaces that define the moving mass. Landslide is a major sliding activity of rocks. Large-scale landslides occurs in steep mountain regions.

In India, parts of Himalayas region are strongly influenced by minor & major slides due to various geological & geotechnical conditions.

All slopes have ~~water~~ tendency to move. These movements vary in origin and magnitude. ~~are~~ depending on the weathered zones & the deep-seated displacements of large rock masses. Movements are controlled by stresses, which originates from external elements. Such as precipitation, temperature, fluctuations etc. whereas movements in the depth zone, are due to stresses within the internal pressure of the rock and soil masses.

Causes of landslide :-

(i) Geology of the region :-

The rock mass is greatly ~~influenced~~ influenced by rock types of the region, regional geology weather ability and geomechanical properties. Weathering of rock mass reduces the stability of slope in the strata. Soil formation due to weathering is more prone to slides. Weatherability influences

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the weaker planes or opening in the rock permits, infiltration of surface water and increases stresses in the rock mass slope.

(i) Structural features: - Geological structural features are mainly responsible for detaching the rock mass from the face of the slope which consequently causes the rock mass to slide down. Bedding planes, fractures, joints, faults, fissures can have a profound influence on the downward slope of rock mass.

(iii) Ground water precipitation: - Slope stability is adversely affected by a rise in the ground water table, resulting in an increase in pore water pressures. A large number of landslides have occurred in the Shiwalik foothills of north-western India due to seepage of ground water & increase in pore pressure.

Rainfall intensity and duration of rainfall also activates landslides. This however depends on other factors, such as gradient of slope, type of rocks, nature of their in-situ conditions.

(iv) In-situ stresses: - The stresses within slope rock material is generated by placing a load or stress at the top of the slope. Such a surcharge can be caused by human activities such as stockpiling of ore deposits, waste disposals, buildings etc.

(V.) Seismic activity :- Earthquakes releases a lot of energy which creates a lot of shear stress that can lead to failure of soil ~~Stata~~ State.

### Landslide investigation.

Field methods

Lab methods.

- ① Map study.
- ② Geological.
- ③ Geotechnical.

### \* Classification of Landslides :-

↓ Falls      ↓ Topples      ↓ Slides      ↓ Spreads

• Mapping of area :- Field maps should be prepared by detailing the affected areas and typical cross-sections which can be used for stability analysis. If possible, the topography may be determined by aerial survey which provides an overall view of site features.

• Geological investigation :- A geological map of the area if available, should be studied carefully. A plan of landslide area must be prepared incorporating geological data. Structural geological features such as bedding planes, joints, faults, folds, shear zone should be studied in the field detail area plotted on the geological map.

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The influence of these Structural geological features on the stability of affected slope should be evaluated.

- Geotechnical investigation: - ~~Geotechnical~~ Geotechnical investigation should be carried out with the objective of determining the nature and strength of material comprising the slope. If the slope is predominantly made up of soil or a mixture of soil and rock, disturbed and undisturbed samples should be collected from a few locations covering the affected area.

→ Laboratory Investigation: -

- (i) Determination of index properties of soil samples.
- (ii) Shear tests.
- (iii) Examination of rock samples to find out the nature of the rocks, extent of weathering, presence of any weak interlayers etc.

\* Falls: - Falls comprise more or less of free and extremely discrete mass movement of material from a rock mass of any size.

\* Topples: - Topples commonly occur in a rock mass with steeply inclined discontinuities and range from small to very large. Topples generally occur in cohesive material and result when a tension failure occurs in the rock mass or soil.

\* **Slides** :- These are formed due to deformation or shear and movement of the rock mass or earth material along a discrete failure surface.

\* **Spreads** :- In spreads, the movement is more or less horizontal and results in rock mass failure along the shear failure surface and tension extends along the vertical surface.

### Remedial measures :-

1. **Assessment of active landslides** :- It is necessary to identify the nature of the slide & its possible behaviour. It ~~may~~ may not be possible to completely stabilize the instability of State, but man-made activities can be controlled.

2. **Management of surface water drainage system** :- A slope drainage system is commonly applied engineering techniques to regulate the surface water. In some instances, sealing of the slide areas is suggested to prevent filtration of water. Afforestation in the slide region is also one of the protective measures of slope movement. The tree root system provides reinforcement to the State.

3.

## → SOIL EROSION

→ ~~Soil~~ Soil erosion is the displacement of the upper layer of soil, it is one form of soil degradation. This natural process is caused by the dynamic activity of erosive agents, that is, water, ice (glaciers), snow, air (wind), plants, animals and human.

→ Factor affecting soil erosion: -

Climate: -

The amount and intensity of precipitation is the main climatic factor governing soil erosion by water.

| M  | T  | W  | T  | F  | S  | S  |
|----|----|----|----|----|----|----|
| 1  | 2  | 3  | 4  | 5  | 6  | 7  |
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Other climatic ~~season~~ factors such as ~~the~~ avg. temperature and temperature range may also effect erosion, via their effects on vegetation and soil properties.

Soil Structure and Composition: -

- 10 → The composition, moisture, and compaction of soil are all major factors in determining the erosivity of rainfall.
- 11 Sediments containing more clay tend to be more resistant to erosion, than those with sand or silt, because the clay helps bind soil particles together.
- 12 Soil containing high levels of organic materials are often more resistant to erosion, because the organic materials coagulate soil colloids and create and strengthen, more stable soil structure.
- 2 Soil compaction also affects the permeability of the soil to water, and hence the amount of water that flows away as runoff.

-Vegetation cover: -

- 4 → Vegetation acts as an interface b/w the atmosphere and the soil. It increases the permeability of soil to rainwater, thus decreasing runoff. It shelters the soil from winds, which results in decreased wind erosion, as well as advantageous changes in microclimate.

-Topography: -

The topography of the land determines the velocity at which ~~surf~~ surface runoff will flow, which in turn determines the erosivity of the runoff.

Longer, steeper slopes are more susceptible to very high rates of erosion during heavy rains than shorter, less steep slopes.

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\* Human activities that increase soil erosion: -

\* Agricultural practices: -

- unsustainable agricultural practices increases rates of erosion by one or two orders of magnitude over the natural.
- rate and far exceed replacement by soil production.
- Heavy grazing reduces vegetation ~~cover~~ cover and causes severe soil compaction, both of which increase erosion rates.
- The tillage of agricultural lands, which breaks up soil into finer particles, is one of primary factors.

\* Deforestation: -

- Deforestation causes increased erosion rates due to exposure of mineral soil by removing the humus and litter layers from the soil surfaces, removing the vegetation cover that binds soil together, and causing heavy soil compaction from logging equipment.

\* Roads and urbanization: -

- Urbanization has ~~major~~ major effects on erosion processes: first by denuding the land of vegetation cover, altering drainage ~~pattern~~ patterns, and compacting the soil during construction; and next by covering the land in an impermeable layer of asphalt or concrete that increases the amount of surface runoff and increases surface wind speed.

\* Climate change: -

- The rise in sea levels that has occurred as a result of climate change has also greatly increased coastal erosion rates.

\* Global environmental effects: -

- one of the most significant global environmental problems are: -

Land degradation: -

Water and wind erosion are now the two primary causes of land degradation, combined, they are responsible for 84% of degraded acreage.

- Sedimentation of aquatic ecosystems: -

→ Soil erosion is considered to be the leading global cause of diffuse water pollution, due to effects of the excess sediments flowing into the world's waterways.

- Airborne dust pollution: -

→ Soil particles picked up during wind erosion of soil are a major source of air pollution, in the form of airborne particulates - dust. These ~~airborne~~ airborne soil particles are often contaminated with toxic chemicals such as pesticides or petroleum fuels, posing ecological and public health hazards when they later land, or are inhaled/ingested.

\* Monitoring, measuring and modeling soil erosion: -

→ Monitoring and modeling of erosion processes can help people better understand the causes of soil erosion, make predictions of erosion under a range of possible conditions, and plan the implementation of preventative and restorative strategies for erosion.

It estimates the average annual soil loss  $A$  on a plot-sized area as:

$$A = RKLSCP$$

where,  $R$  is the rainfall erosivity factor,  $K$  is the soil erodibility factor,  $L$  and  $S$  are topographic factors representing length and slope,  $C$  is the cover and management factor and  $P$  is the support practices factor.

### \* prevention and remediation: -

The most effective known method for erosion prevention is to increase vegetation cover on the land which helps prevent both wind and water erosion.

→ Terracing is an extremely effective means of erosion prevention ~~is to increase veg. control~~, which has been practiced for thousands of years by people all over the world.

→ Wind breaks are rows of trees and shrubs that are planted along the edges of agricultural fields to shield the fields against winds.

→ Traditional ~~planning~~ planting methods, such as mixed cropping and crop rotation have also been shown to significantly reduce erosion rates.

→ Crop residues play a role in the mitigation of erosion, because, because they reduce the impact of raindrops breaking ~~up~~ up the soil particles.

## FOREST FIRE

During summer, when there is no rain for months, the forests become littered with dry desiccated leaves and twigs, which could burst into flames ignited by the slightest spark.

Causes of forest fire:-

→ Forest fire caused by natural causes ~~and~~ as well as man-made causes.

• Natural causes:- Many forest fires start from natural causes such as lightning which set trees on fire. High atmospheric temperatures and dryness offer favorable circumstance for a fire to start.

• Man-made causes:- Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material.

- Environmental cause:- These are largely related to climatic conditions such as temperature, wind speed and direction, level of moisture in soil and atmosphere and duration of dry spells.

- Human related causes → result from human activity as well as methods of forest management.

→ the use of fires by villagers to ward off wild animals.  
→ fires lit intentionally by people living around forests for recreation.  
→ fires ~~start~~ started accidentally by careless visitors to forests who discard cigarette butts.

## \* Classification of forest fire :-

- Forest fire can broadly be ~~for~~ classified into three categories
- Natural or controlled forest fire
- Forest fires caused by heat generated in the litter and other biomas in ~~summer~~ summer through carelessness of people
- Forest fires purposely caused by local inhabitants.

## \* Types of forest fires :-

→ There are two types of forest fire

- (i) Surface fire and (ii) Crown fire.

## \* Surface fire :-

- A forest fire may burn primarily as a surface fire, spreading along the ground as the surface litter, on the forest floor and is engulfed by the spreading flames.

## \* Crown fire :-

- The other type of forest fire is a crown fire in which the crown of trees, and shrubs burn, often.

## \* EFFECTS OF FOREST FIRES :-

- ① ~~Forest~~ Forest fires cause soil erosion, floods, natural vegetation, loss of animals and birds.
- ② It is degrading environment and affects on flora and fauna.
- ③ Forest fires is one of the major environmental issues facing today, due to carbon ~~dioxide~~ being released in the atmosphere, and it is commonly called 'Green house effect'.

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### \* FOREST FIRE PREVENTION TIPS:-

- ① Obey local laws regarding open fires, including campfires.
- ② Keep all flammable objects away from fire.
- ③ Have firefighting tool nearby and handy.
- ④ Carefully dispose of hot charcoal.
- ⑤ Drown all fires.
- ⑥ Carefully extinguish smoking materials.