

Landslide

Landslide, otherwise called landslip is the downslope movement of a mass of rock, debris, earth or soil. Landslides occur when gravitational and other types of shear stresses within a slope surpass the shear strength of the materials that form the slope. The formation of shear stresses within a slope can take place through oversteepening of the base of the slope by natural erosion, loading of the slope by inflow of water, increase in the level groundwater table or due to accumulation of debris on the slope's surface. Short term stresses caused by earthquakes and rainstorms also contribute to the activation of landslides. So, the activation process of the landslide depends on the shear strength of the slope's material.

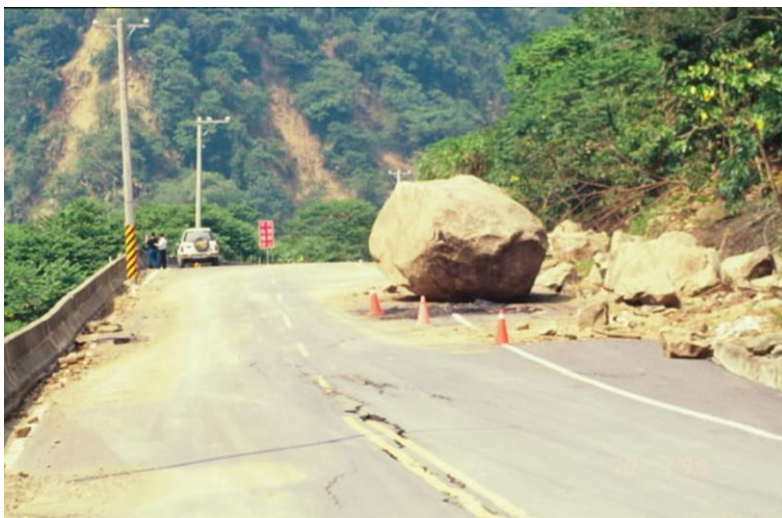


Figure: Picture of landslide

Three factors control the shear strength of the slope forming materials:

- **Frictional** strength which is the resistance to movement between the slope material's interacting constituting particles.
- **Cohesive** strength which is the bonding between the particles.
- **Spatial disposition** of its constituent particles (sediment fabric).

Types of Landslides

Landslides are classified on the basis of

- i) Type of movement (slides, flows, topples and falls)
- ii) Type of materials (rock, debris or earth)

Sometimes more than one type of movement occurs within a single landslide and due to temporal and spatial relationships of these movements, it becomes complex. Their analysis

often requires detailed interpretation of landforms and geological sections. Rockslides and other slides include the displacement of material along one or more discrete shearing surfaces. The sliding can be translational (planar surface) and rotational (concave upward set).

- Falls: Falls are sudden movements of loads of soil, debris, and rock that break away from slopes and cliffs. Falls landslides occur as a result of mechanical weathering, earthquakes, and force of gravity.
- Slides: This is a kind of mass movement whereby the sliding material breakaways from underlying stable material. The kinds of slides experienced during this type of landslide include rotational and transitional. Rotational slides are sometimes known as slumps since they move with rotation. Transitional slides consist of a planer or dimensional surface of rupture. They involve landslide mass movement following a roughly planar surface with reduced rotation or backward slanting. Slides occur when the toe of the slope is undercut. They move moderately, and the consistency of material is maintained.
- Topples: Topple landslides occur when the topple fails. Topple failure encompasses the forward spinning and movement of huge masses of rock, debris, and earth from a slope. This type of slope failure takes place around an axis near or at the bottom of the block of rock. A topple landslide mostly lead to formation of a debris cone below the slope.



Figure: Picture of topples

- Spreads: They are commonly known as lateral spreads and takes place on gentle terrains via lateral extension followed by tensile fractures.

- **Flows:** This type of landslide is categorized into five; earth flows, debris avalanche, debris flow, mudflows, and creep, which include seasonal, continuous and progressive. Flows are further subcategorized depending upon the geological material, for example, earth, debris, and bedrock.

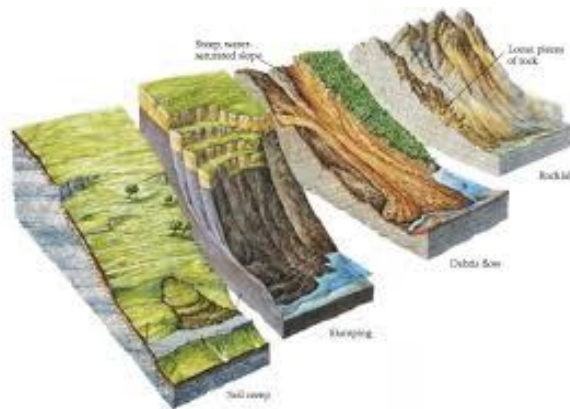


Figure: Picture of debris and creeps

Causes of Landslides

Landslides occur when the slope undergoes some processes that change its condition from stable to unstable. This is essentially due to a decrease in the shear strength of the slope material, to an increase in the shear stress. A change in the stability of a slope can be caused by a number of factors. Natural causes of landslides include:

- **Climate:** Long-term climatic changes can significantly impact soil stability. A general reduction in precipitation leads to lowering of water table and reduction in overall weight of soil mass, reduced solution of materials and less powerful freeze-thaw activity. A significant upsurge in precipitation or ground saturation would dramatically increase the level of ground water. When sloped areas are completely saturated with

water, landslides can occur. If there is absence of mechanical root support, the soils start to run off.

- Earthquakes: Seismic activities have, for a long time, contributed to landslides across the globe. Any moment tectonic plates move, the soil covering them also moves along. When earthquakes strike areas with steep slopes, on numerous occasions, the soil slips leading to landslides.
- Weathering: is the natural procedure of rock deterioration that leads to weak, landslide-susceptible materials. Weathering is brought about by the chemical action of water, air, plants and bacteria. When the rocks are weak enough, they slip away causing landslides.
- Erosion: caused by sporadic running water such as streams, rivers, wind, currents, ice and waves wipe out latent and lateral slope support enabling landslides to occur easily.
- Volcanoes: Volcanic eruptions can trigger landslides. If an eruption occurs in a wet condition, the soil will start to move downhill instigating a landslide. Stratovolcano is a typical example of volcano responsible for most landslides across the globe.
- Forest fires: instigate soil erosion and bring about floods, which might lead to landslides.
- Gravity: Steeper slopes coupled with gravitational force can trigger a massive landslide.

Landslides are aggravated by human activities, such as:

- deforestation, cultivation and construction
- vibrations from machinery or traffic
- blasting and mining
- earthwork (e.g. by altering the shape of a slope, or imposing new loads)
- agricultural or forestry activities (logging), and urbanization, which change the amount of water infiltrating the soil

Effect of landslides

- **Lead to economic decline:** Landslides have been verified to result in destruction of property. If the landslide is significant, it could drain the economy of the region or country. After a landslide, the area affected normally undergoes rehabilitation. This rehabilitation involves massive capital outlay.
- **Decimation of infrastructure:** The force flow of mud, debris, and rocks as a result of a landslide can cause serious damage to property. Infrastructure such as roads, railways, leisure destinations, buildings and communication systems can be decimated by a single landslide.
- **Loss of life:** Communities living at the foot of hills and mountains are at a greater risk of death by landslides. A substantial landslide carries along huge rocks, heavy debris and heavy soil with it. This kind of landslide has the capacity to kills lots of people on impact.
- **Affects the beauty of landscapes:** The erosion left behind by landslides leaves behind rugged landscapes that are unsightly. The pile of soil, rock and debris downhill can cover land utilized by the community for agricultural or social purposes.
- **Impacts river ecosystem:** The soil, debris, and rock sliding downhill can find way into rivers and block their natural flow. Many river habitats like fish can die due to interference of natural flow of water. Communities depending on the river water for household activities and irrigation will suffer if flow of water is blocked.

Landslide Prevention Methods

- **Slope vegetation:** One of the quickest and easiest ways to prevent a landslide on a slope is to vegetate it. This landslide prevention method works best on slopes that are not too steep or if the movement hasn't already begun.
- **Retaining walls:** A solid, well-designed retaining should be made of sturdy materials such as masonry, brick, stone or steel. Drainage materials behind the wall help increase the stability of the wall.
- **Diverting debris pathway:** Building pathways to divert debris is another option to prevent landslides on your property.
- **Temporary prevention:** For temporary landslide prevention, sandbags can be used to divert water from uncontrolled spilling just as retaining walls or diverted pathways do.

Another method is to protect unstable areas with plastic sheeting, tarps or even burlap, especially in areas without vegetation because of recent fires.