

## UNIT-V

### **NATURAL HAZARDS (LANDSLIDES, EARTHQUAKES, FLOODS)**

Land slide refers to the downward sliding of huge quantities of land masses. Generally, such slides occurs along steeper slopes of hills or mountains. It must be sudden or slow in the occurrence. Also, in magnitude, it may be major or minor. Often, loose and unconsolidated surfacial material undergoes sliding. But sometimes, huge blocks of consolidated rocks may also be involved.

Landslides are generally, of no concern and can just be ignored if they occur in uninhabited places and places of no human interest. But if they occur in places of importance such as highways, railway lines, valleys, reservoirs, inhabited areas and agricultural lands, obviously, such instances lead to blocking of traffic, collapse of buildings, harm to fertile lands and so apart from heavy loss of life and property.

#### **Causes of Landslides**

Landslides occur due to various causes, Broadly they may be grouped into two types, • i.e. inherent or internal cause and immediate causes. Of these, the internal cause are responsible to the extent of creating favorable or suitable conditions for landslide occurrence. The other sets of causes, i.e. immediate cause, play the role of overcoming this frictional resistance or inertia by providing necessary energy in the form of sudden jerk, for the actual occurrence of landslide.

#### **Internal Causes**

The causes which are inherent in the land mass concerned are again of various types such as influences of slope, associated water, constituent lithology, associated geological structures, human factors, etc.

#### **Landslides Effects of Slope**

•This is very important factor which provides favorable conditions for landslides occurrence. It is both directly and indirectly responsible for land slips. Steeper slopes are prone to land slips of loose overburdens due to great gravity influence, whereas gentle slopes are not prone to such land slips because, in such cases, loose overburden encounters greater frictional resistance; hence any possible slip is stalled.

It is common observation that any loose material, if piled up, shall have a natural slope of about 35 0 C called the angle of repose. • However, it should be remembered that hard consolidated and fresh rocks remain stable even against any slope, unless they are adversely affected by other lithological and structural factors.

#### **Landslides Effects of Water**

This is the most important factor which is mainly responsible for landslide occurrence. This is so because it adversely affects the stability of the loose ground in different ways.

The presence of water greatly reduces the intergranular cohesion of the particles of loose ground. This weakens the ground inherently and therefore, makes it prone to landslide occurrences.

On hill slopes, water on percolation through the overlying soil zone may flow down as a film or thin sheet of water above the underlying hard rocks.

Along hill slopes, rain water, while percolates down, carries with it fine clay and silty material which may form a thin band at the interface of loose overlying material and underlying hard work.

Water, being the most powerful solvent, not only causes decomposition of minerals but also leaches out the soluble matter of rocks. This reduces the compaction or cohesion of the rock bodies and make it a weak mass.

### **Landslides Effects of Lithology**

The nature of rock types also influences landslide. For ex. Rocks which are highly fractured, porous and permeable are prone to landslide occurrence because they give scope for the water to play an effective role.

Rocks which are rich in certain constituents like clay, mica, calcite, gypsum, rock salt and calcareous cementing material are more prone to landslide occurrence because they are easily leached out, causing porosity and permeability, landslide occurrence because they are easily leached out, causing porosity and permeability. Thinner Strata are more susceptible to sliding than thicker strata.

### **Landslides and Effects of Geological Structures**

The geological Structures which increase the chances of landslide occurrence are inclined bedding planes, joints, faults or shear zones. All these are plane of weakness. When their dip coincides with that of the surface slope they create conditions of instability.

### **Landslides Immediate Causes**

The different causes listed earlier simply create favorable conditions for the occurrence of landslides, but they themselves do not bring about the actual occurrence of landslides. Otherwise, landslides could have occurred anywhere and at any time just if the case were present. But the fact that the landslide occur suddenly at certain times only, indicate that these causes only prepare the ground but because of factors such as frictional resistance the overlying mass will remain in the same place in a critical condition.

Hence such an impulse, which is a sudden jolt or jerk or vibration of the ground, acts as the immediate cause for the occurrence of landslides. This sudden jolting phenomenon of the ground may, in turn, be due to the different natural and artificial reasons like avalanche, volcanic eruptions, falls of meteorite, occurrence of earthquake, blasting of explosives in quarrying, tunneling, road cutting or mining.

### **Effects of Landslides**

From the Civil Engineering Point of view, if landslide occurs at vulnerable places, they may cause:

- (i) Disruption of transported or blocking of communications by damaging roads and railways and telegraph poles;

- (ii) Obstruction to the river flow in valleys, leading to their overflow and floods;
- (iii) Damage to sewer and other pipelines
- (iv) Burial or destruction of buildings and other construction

### **Preventive Measures for Landslides**

To prevent the occurrence of landslides, it would be logical to take such steps which would counter the effects of those factors responsible for landslide occurrence. The main factors which contribute to landslide occurrence are slope, water content, structural defects, unconsolidated or loose character of the overburden, lithology and human interferences.

#### **Retaining walls To Counter the effect of slope**

Retaining walls may be constructed against the slopes, so that the material which rolls down is not only prevented from further fall but also reduces the slope To Counter the effects of water

A proper drainage system is the suitable measure. This involves the quick removal of percolated moisture by means of surface drainage and subsurface drainage.

The different structural defects such as weak planes and zones may be either covered or grouted suitably so that they are effectively sealed off. These measures not only prevent the avenues for percolation of water but also increase the compaction or cohesion of the material concerned.

### **Grouting to Prevent Landslides**

Not to resort to reduce the stability of existing slopes

This is done by not undertaking any undercutting on the surface slope and by not undertaking any construction at the top of the hills.

To Counter the loose nature of the overburden

Growing vegetation, plants and shrubs on loose ground helps in keeping the loose soil together.

Avoiding heavy traffic and blasting operations near the vulnerable places naturally helps in preventing the occurrence of landslides.

## **AN EARTHQUAKE**

An earthquake (also known as a quake, tremor or tremor) is the shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth's lithosphere that creates seismic waves. Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to toss people around and destroy whole cities. The seismicity or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.

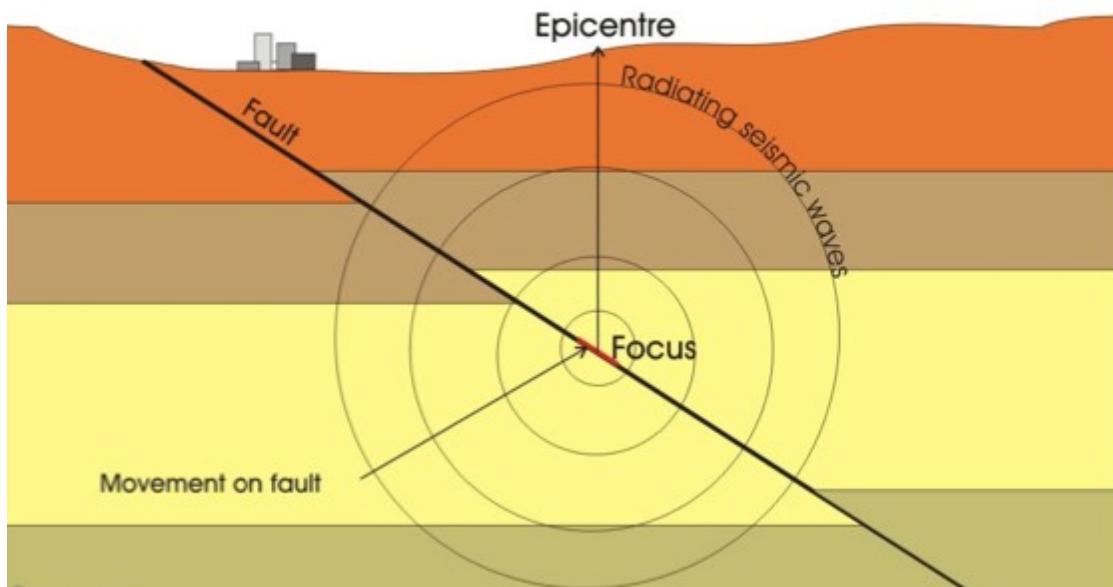
## **AN EARTHQUAKE TERMINOLOGY**

Every tremor produces different types of seismic waves, which travel through rock with different velocities:

Longitudinal p-waves (shock- or pressure waves)

Transverse s-waves (both body waves)

Surface waves — (rayleigh and love waves)



## EFFECTS OF AN EARTHQUAKES

- Landslides and avalanches
- Fires
- Soil liquefaction
- Tsunami
- Floods
- Human impacts

## FLOODS

A flood is an overflow of water that submerges land that is usually dry. A flood as a covering by water of land by "flowing water",.

Flooding may occur as an overflow of water from water bodies, such as a river, lake, or ocean, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an areal flood.

Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway.

## Principal types

Areal

Riverine (Channel)  
Estuarine and coastal  
Urban flooding  
Catastrophic

### **Causes**

Upslope factors  
Downslope factors  
Coincidence

### **Effects**

#### *Primary effects*

The primary effects of flooding include loss of life, damage to buildings and other structures, including bridges, sewerage systems, roadways, and canals.

#### *Secondary and long-term effects*

Economic hardship due to a temporary decline in tourism, rebuilding costs, or food shortages leading to price increases is a common after-effect of severe flooding. The impact on those affected may cause psychological damage to those affected, in particular where deaths, serious injuries and loss of property occur

### **Benefits**

Floods (in particular more frequent or smaller floods) can also bring many benefits, such as recharging ground water, making soil more fertile and increasing nutrients in some soils. Flood waters provide much needed water resources in arid and semi-arid regions where precipitation can be very unevenly distributed throughout the year and kills pests in the farming land. Freshwater floods particularly play an important role in maintaining ecosystems in river corridors and are a key factor in maintaining floodplain biodiversity. Flooding can spread nutrients to lakes and rivers, which can lead to increased biomass and improved fisheries for a few years.

For some fish species, an inundated floodplain may form a highly suitable location for spawning with few predators and enhanced levels of nutrients or food. Fish, such as the weather fish, make use of floods in order to reach new habitats. Bird populations may also profit from the boost in food production caused by flooding.

Periodic flooding was essential to the well-being of ancient communities along the Tigris-Euphrates Rivers, the Nile River, the Indus River, the Ganges and the Yellow River among others. The viability of hydropower, a renewable source of energy, is also higher in flood prone regions.

### **Flood safety planning**

**Planning for flood safety involves many aspects of analysis and engineering, including:**

- observation of previous and present flood heights and inundated areas,
- statistical, hydrologic, and hydraulic model analyses,
- mapping inundated areas and flood heights for future flood scenarios,
- long-term land use planning and regulation,
- engineering design and construction of structures to control or withstand flooding,
- intermediate-term monitoring, forecasting, and emergency-response planning, and
- short-term monitoring, warning, and response operations.

### **Control of floods**

In many countries around the world, waterways prone to floods are often carefully managed. Defenses such as detention basins, levees, bunds, reservoirs, and weirs are used to prevent waterways from overflowing their banks. When these defenses fail, emergency measures such as sandbags or portable inflatable tubes are often used to try to stem flooding. Coastal flooding has been addressed in portions of Europe and the Americas with coastal defenses, such as sea walls, beach nourishment, and barrier islands.

In the riparian zone near rivers and streams, erosion control measures can be taken to try to slow down or reverse the natural forces that cause many waterways to meander over long periods of time. Flood controls, such as dams, can be built and maintained over time to try to reduce the occurrence and severity of floods as well.