STABILITY OF HILL SLOPE

SLOPE: An exposed ground surface that stands at an angle with horizontal is called an unrestrained slope.

STABILITY: is determined by balance of shear stress and shear strength.

Stable slope may be initially affected by preparatory factors, making the slope conditionally unstable.

TRIGGERING FACTOR of a slope failure can be climatic events which can make a slope unstable, leading to mass movement. Mass movement can be caused by increase in shear stress, such as loading, lateral pressure and transient forces. Alternatively, shear strength may be decreased by weathering, change in pore water pressure, and organic material.

In Figure 1. a block of rock situated on a rock slope is being pulled toward Earth's centre (vertically down) by gravity. We can split the vertical gravitational force into two components relative to the slope: one pushing the block down the slope (the **shear force**), and the other pushing into the slope (the **normal force**). The shear force, which wants to push the block down the slope, has to overcome the strength of the connection between the block and the slope, which may be quite weak if the block has split away from the main body of rock, or may be very strong if the block is still a part of the rock. This is the **shear strength**, and in Figure 15.2a, it greater than the shear force, so the block should not move. In Figure 1. b the slope is steeper and the shear force is approximately equal to the shear strength. The block may or may not move under these circumstances. In Figure 1. c, the slope is steeper still, so the shear force is considerably greater than the shear strength, and the block will very likely move.

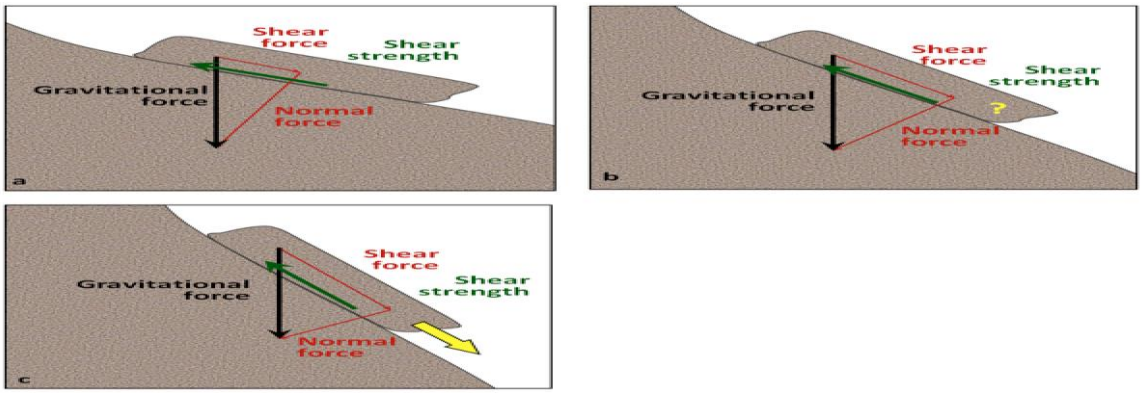


Figure 1Differences in the shear and normal components of the gravitational force on slopes with differing steepness. The gravitational force is the same in all three cases. In (a) the shear force is substantially less than the shear strength, so the block should be stable. In (b) the shear force and shear strength are about equal, so the block may or may not move. In (c) the shear force is substantially greater than the shear strength, so the block is very likely to move. [SE]

The field slope stability encompasses static and dynamic stability of slope of earth and rock fill dams, slope of other types of embankments, excavated slopes and natural slopes in soil and soft rocks.

TYPES OF SLOPE:

W.R.T Extent

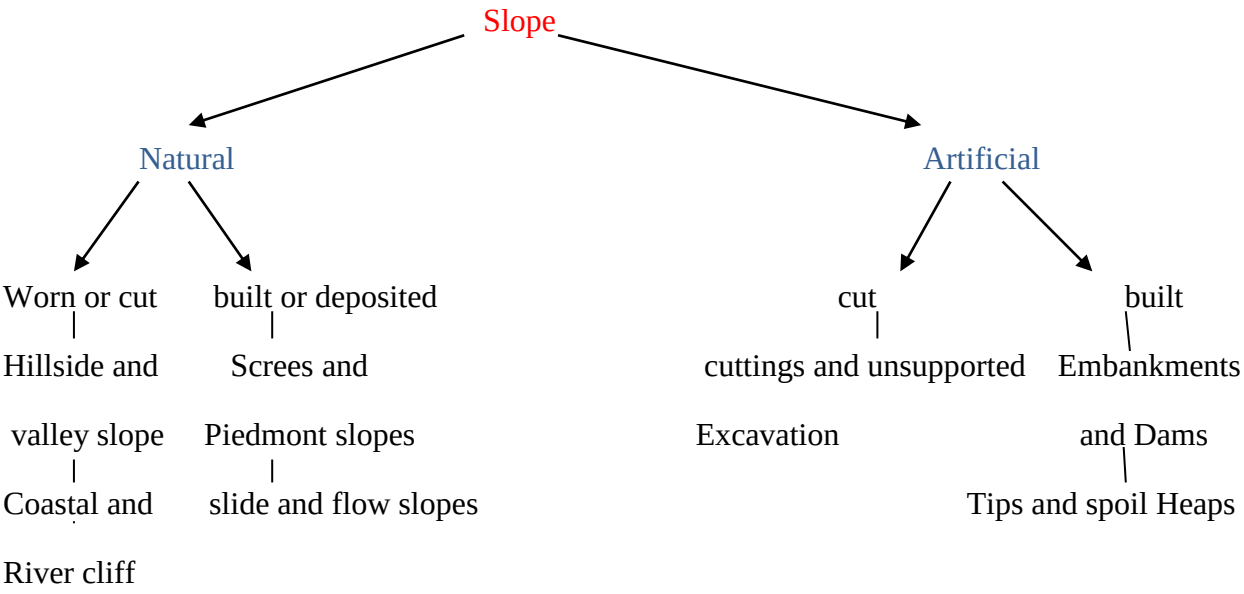
1. INFINITE SLOPE: they have dimensions that extend over great distance and the soil mass is inclined to

horizontal. Eg. Long slope of a mountain face.

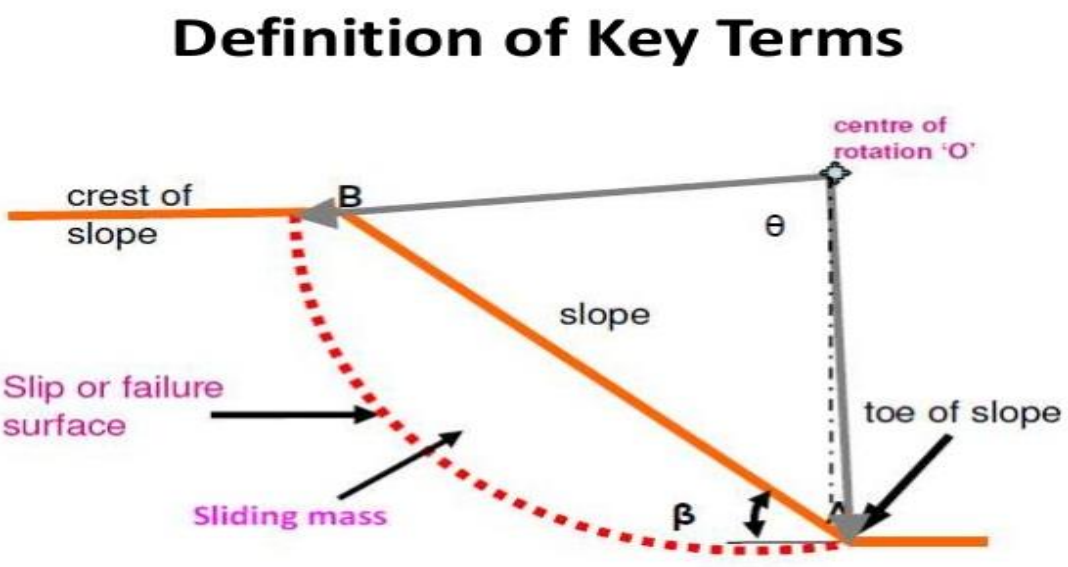
2. Finite Slope: is one with a base and top surface, the height being limites.

The inclined faces of earth dams, embankments and excavation . eg: typical man made slope.

W.R.T method of construction



TERMINOLOGIES:



1. **Slip or Failure Zone** : It is a thin zone of soil that reaches the critical state or residual state and results in movement of upper soil mass.
2. **Slip plane or failure plane or slip surface or failure surface** : It is the surface of sliding.
3. **Sliding mass**: It is the mass of soil within the slip plane and the ground surface.
4. **Slope angle**: It is the angle of inclination of a slope to the horizontal . The slope angle is sometimes referred to as a ratio, for example 2:1 (horizontal: Vertical

PRINCIPLES OF SLOPE STABILITY

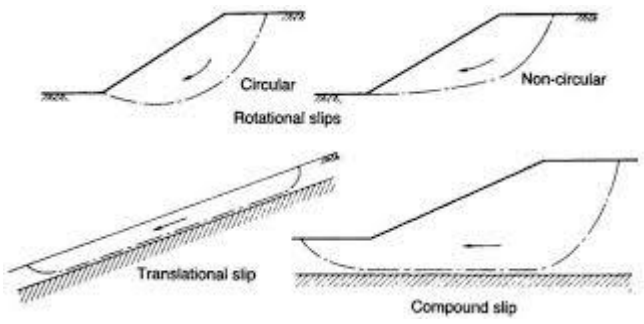
Most landslide progress by sliding along surface within the soil and rock. The surface along which this sliding is most likely to occur depends on:

1. The geometry of slope (i.e the slope angle)
2. The properties of slope material
3. The presence of any weak zones or discontinuities in the slope and their orientation relative to slope zone.

TYPES OF SLOPE FAILURE:

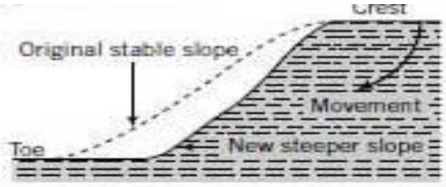
1. **Circular Slips** : They are related to homogenous, isotropic soil condition .

2. **Non- circular slips** : associated with non-homogeneous soil conditions.
3. **Translational failure**: this type of failure takes place where the form of failure surface is affected by the presence of an adjacent stratum of different strength and adjacent stratum is fairly shallow.
4. **Compound failure**: It occurs where the form of failure surface is affected by the presence of an adjacent stratum of different strength and the adjacent stratum is relatively deep.

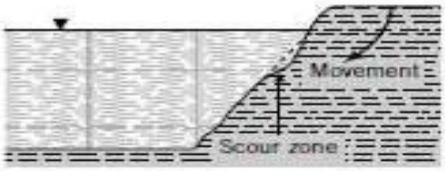


CAUSES OF SLOPE FAILURE:

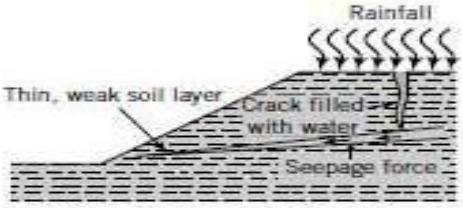
1. **Erosion** : The wind and flowing water causes erosion of top surface of slope and make the slope steep and thereby increase the tangential component of driving force.
2. **Steady Seepage** : Seepage force in the slope direction add to gravity forces and make the slope susceptible to instability. The pore water ressure decrease the shear strength . The condition is critical for downstream slope.
3. **Rainfall**: Long periods of rainfall saturate , soften and erode soils. Water enters into exixting cracks and many weakens underlying soil layers leading to failure, for example mud slides.
4. **Earthquake**: They induce dynamic shear force. In additional there is sudden build up of pore water pressure that reduces available crest shear strength.
5. **External loading**: additional loading placed on the top of the slope increases the gravitational forces that may cause the slope fail.



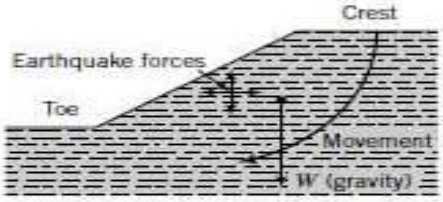
(*a*) Steepening of slope by erosion



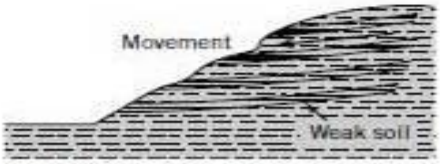
(*b*) Scour by rivers and streams



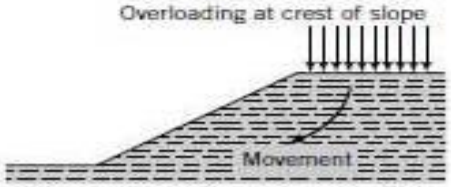
(*c*) Rainfall fills crack and introduces seepage forces in the thin, weak soil layer



(*d*) Gravity and earthquake forces



(*e*) Geological feature—soil stratification



(*f*) Overloading at the crest of the slope