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SLOPE STABILITY STUDY

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ABSTRACT

An earth is an unsupported inclined surface of soil mass. The evolution of slope stability analyses in geotechnical engineering has followed closely the developments in soil and rock mechanics as a whole. Slopes either occur naturally or are engineered by humans. Slope stability problems have been faced throughout history when men and women or nature has disrupted the delicate balance of natural soil slopes. Furthermore, the increasing demand for engineered cut and fill slopes on construction projects has only increased the need to understand analytical methods, investigative tools, and stabilization methods to solve slope stability problems. The slopes are made for railway formation, highways, embankments, earth dams and many other locations. The stability of these embankments or slopes is important because their failure may leads to loss of human life's as well as economical loss. Landslide is also a part of unstable slope. Landslide may occur slowly or suddenly. Usually slides are due to excavation or undercutting the foot of an existing slope or by gradual disintegration of the structure

Keywords –Geological Structure, Slope, Stability, Vegetation, Water Content

I. INTRODUCTION

The stability of natural and man-made slopes is an important concern for numerous types of site uses and objectives, including the development or protection of infrastructure, Homes and natural resources. Slope stability is often the most critical safety issue or Feasibility component for dams and hydroelectric facilities, landfills, quarries and Borrow pits, water storage tanks, bridge abutments, and residential developments in Hill slope environments. Slope stability depends in large part upon the geological and geotechnical characteristics of the bedrock and soil that compose the slopes. Not surprisingly, the strength of these materials plays an important role in slope stability. For slopes composed predominantly of bedrock, however, often the most important factor is the geologic structure of the rock. Geological structure refers to the location, orientation, and spacing of discontinuities within the bedrock mass. Such discontinuities include those along bedrock bedding, bedrock joints, faults, and shears.

Geological structure, in particular the orientation of bedding, was thought to be a key factor for slope stability study. Investigators observed that most landslides which had occurred at the site appeared to have slide along bedding. Additionally, slope stability analyses representing several locations at the site indicated that the stability of the slopes was sensitive to bedding orientation.

Slope failures are complex events and the factors that affect slope stability are difficult to measure, particularly shear strength parameter values of the soil and ground water conditions. Ideally, the stability problems can be

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discovered and addressed before a slope failure occurs. However, once a failure occurs or a potential failure is identified, information and knowledge of the major factors resulting in the failure are required to develop an effective remediation plan. It is necessary to evaluate the stability of the concerned slopes, or to investigate the causes of the slope failures, in a rapid and effective way.

II. FACTORS RESPONSIBLE TO CAUSE INSTABILITY OF SLOPES

Following are the factors which causes the instability of slopes-

- Rise of the slope.
- High frequency vibrations.
- Creep and shrinkage on the slope.
- Rapid drawdown.
- Change in Ground Water Table Level.
- Large scale deformation of the earth crust.

III. AIMS OF SLOPE STABILITY ANALYSIS

In most applications, the primary purpose of slope stability analysis is to contribute to the safe and economic design of excavations, embankments, earth dams, landfills. Slope stability evaluations are concerned with identifying critical geological, material, environmental, and economic parameters that will affect the project, as well as understanding the nature, magnitude and frequency of potential slope problems. When dealing with slopes in general and slope stability analysis in particular, previous geological and geotechnical experience in an area is valuable.

The aims of slope stability analyses are

- To understand the development and form of natural slopes and the processes responsible for different natural features.
- To assess the stability of slopes under short-term (often during construction) and long-term conditions.
- To assess the possibility of landslides involving natural or existing engineered slopes.
- To analyze landslides and to understand failure mechanisms and the influence of environmental factors.
- To enable the redesign of failed slopes and the planning and design of preventive and remedial measures, where necessary.
- To study the effect of seismic loadings on slopes and embankments.

The analysis of slopes takes into account a variety of factors relating to topography, geology, and material properties, often relating to whether the slope was naturally formed or engineered

IV. TYPES OF SLOPES

4.1 Natural slopes

The slopes formed by continuous process of erosion and deposition by natural agencies are called as natural slopes. e.g. hill sides and river banks etc. Many projects intersect ridges and valleys, and these landscape

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features can be prone to slope stability problems. Natural slopes that have been stable for many years may suddenly fail because of changes in topography, seismicity, groundwater flows, loss of strength, stress changes, and weathering. Knowing that old slip surfaces exist in a natural slope makes it easier to understanding predict the slope's behavior. Such slip surfaces often result from previous landslides or tectonic activities. The slip surfaces may also be caused by other processes, including valley rebound, glacial shove, and glacial phenomena and non uniform swelling of clays and clay–shales. The materials most likely to exhibit progressive failure are clays and shales possessing chemical bonds that have been gradually disintegrated by weathering.

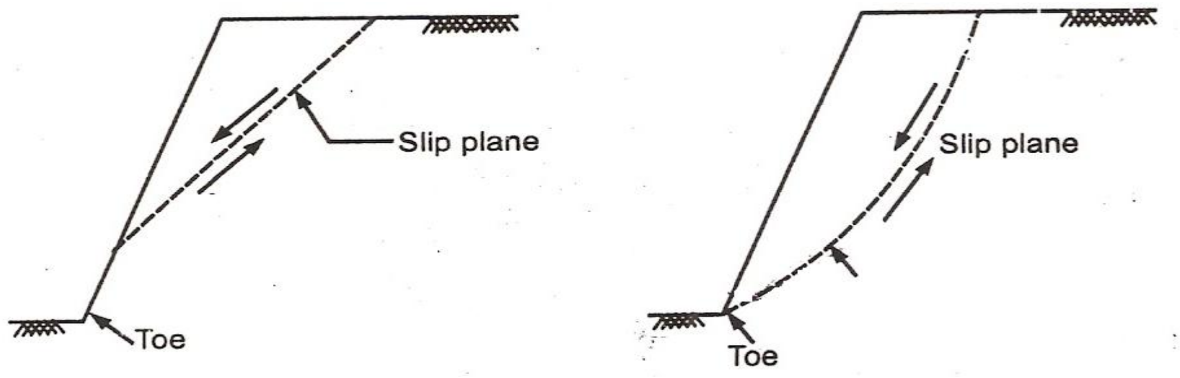
4.2 Engineered slopes

The slopes which results from human construction activities are called as engineered or man-made slopes. E g. slopes of embankments of dams, roads, rails, canals, cuts and fills for the roads and rails etc. Engineered slopes may be considered in three main categories: embankments, cut slopes, and retaining walls.

V. MODES OF FAILURE OF SLOPES

Slope failure: If the failure occurs along a surface of sliding that intersects the slopes, the slide is known as slope failure. The slope failure occurs when the slope material is weaker than base material. Slope failure may be of two types:

Face failure: This is also called as shallow failure. If the slip surface or the arc of failure intersects the slope above the toe, it is known as face failure. For the face failure, the slide may be a plane slide or a rotational slide.



a. Plane slide **b. Rotational slide**

Toe failure: If the arc of failure passes through the toe,it is known as toe failure.For toe failure the slide may be a plane slide or a rotational slide.

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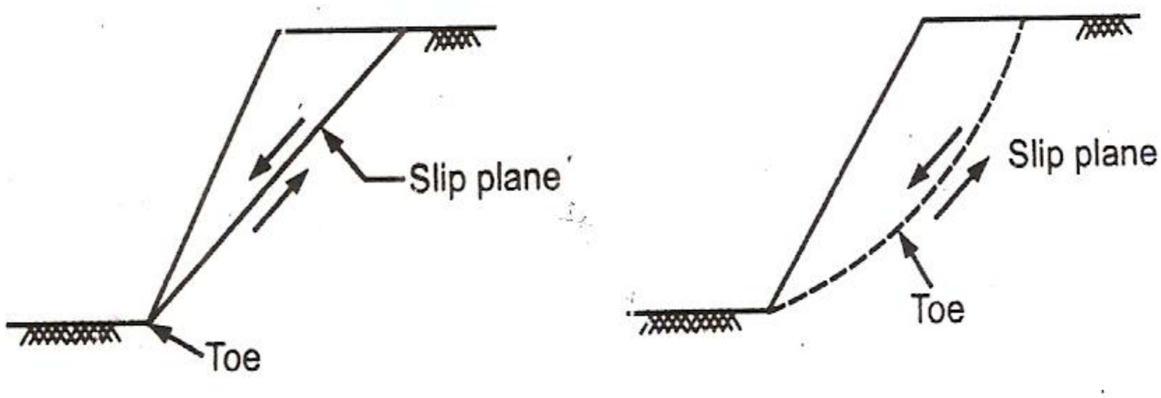
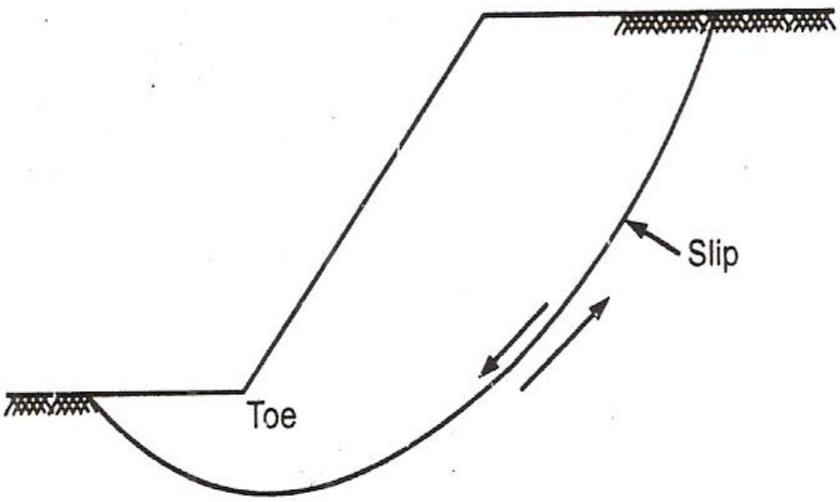


a. Plane slide b. Rotational slide

Toe failure

Base failure

If the failure occurs along a surface of sliding that passes below the toe i.e. through the base, the slide is known as base failure. Base failure occurs when the base material is weaker than the slope material.



Base Failure- rotational slide

VI. METHODS OF ANALYSIS

Culman's method: Culman considered a simple failure mechanism of a slope of homogeneous soil with plane failure surface passing through the toe of the slope. This method is suitable for very steep slope.

Swedish slip circle method: The method developed by Swedish engineers assumes that the surface sliding is an arc of a circle.

Friction circle method: The friction circle method also assumes the failure surface as the arc of the circle.

Bishop's method: Bishop took into consideration the forces acting on the sides of the slices which were neglected in the Swedish method. The slip surface is assumed to be an arc of a circle and the factor of safety

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against sliding is defined as the ratio of actual shear strength of soil to that required to maintain limiting equilibrium.

VII. CONCLUSION

Vegetation plays an important role in stability of slopes. The effects of vegetation are more significant in slopes with low values of effective cohesion where shallow planar failures are likely to occur. For slopes containing piles, analytical expressions have been derived that allow the force needed to increase the factor of safety to a desired value.

VIII.ACKNOWLEDGMENT

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