

## **Geotechnical evaluation and the effects of climate change on Herth landslide, Chitral District, Khyber Pakhtunkhwa, Pakistan**

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### **Abstract**

This study examines the effect of geotechnical parameters in triggering of landslide and indicates the possible influence of climate-landslide relationship. Herth landslide lies in upper Chitral valley and covers a vast area of 7.5 km<sup>2</sup>, where downward movement along a slope is a continuous phenomenon. It comprises of low and high grade metamorphic rocks and granitic intrusions bounded by Tirich Mir fault to the north and Reshun fault to the north-east while Ayun fault and MKT bound it in the south.

Field survey involved collection of 9 disturbed samples and 5 undisturbed soil samples at depth of 1m by box method. The topographic survey using Total Station was for slope distance, vertical angle, and horizontal angle from a setup point to a foresight point. Global Positioning System (GPS) was used to record the relevant spatial information. The secondary data of monthly and annual temperature and rainfall of past 30 years was collected from metrological department and an inventory map was prepared to show frequency of landslides under different climatic conditions using ArcGIS 10.2. The soil index properties tests were carried out to determine different geotechnical properties and direct shear box test was performed to obtain shear strength parameters (cohesion  $c$  and angle of internal friction  $\phi$ ). Further, FLAC software was used to find out factor of safety and slip surface.

The undisturbed soil samples based on their gradation were classified as Silty Clay with Sand (SC-SM), Silty Sand with Gravel (SM) and poorly graded Silty Sand with Gravel (SP-SM). Similarly the disturbed samples were sandy lean Clay (CL), Sandy Silt (ML) and Sandy Silty Clay with low plasticity (CL-ML). The topographic survey results obtained were latterly plotted in ArcGIS software to generate surfaces and contours between 8-10m. On the basis of climatic conditions it has been assessed that Chitral benefits very little from monsoon and mass movement is high in early summers as streams and springs remain active in that duration. The slip surface achieved from FLAC model give overall minimum factor of safety and it is the area where actually displacement of landslide occurs.