SLOPE STABILITY ANALYSIS OF KHATINJ DEFORMED SLOPE, CHITRAL (PAKISTAN) USING 2D LIMIT EQUILIBRIUM METHOD AND 3D FINITE DIFFERENCE METHOD

Muhib Ullah Khan[1]; and Wasiq Lutfi[2]

[1]School of Engineering & Technology, China University of Geosciences, Beijing 100083, PR China

[2]School of Earth Sciences and Resources, China University of Geosciences, Beijing 100083, PR China

muhibkpk@yahoo.com

Abstract

Landslides constitute a major geological hazard in the world due to their high financial cost and their nondiscriminatory nature and are the main natural hazards occurring in the mountainous area situated in the Chitral, Pakistan. The study area Khatinj, Chitral, as a part of Hindu Kush range, northern Pakistan, situated over the NW corner of collision region of Indian and Eurasian plate. Khatinj deformed slope is located in the Upper Chitral valley is an ongoing downward movement along tension cracks across several slopes in 1.5 km2 area. According to Kazmi and Jan (1997) the area is bounded by the Tirich Mir fault in the north, Reshun fault in the north-east, Ayun fault and Main Karakorum Thrust in the south, and Karakorum fault in the west. It is one of the most tectonically active regions because of the abduction processes of Eurasian plate. That is why it is one of the most disaster-prone regions to devastating impacts of landslides on the communities. The region is frequently subjected to damages, human loss and disruption by rock fall, sliding of debris and rock, debris flow, mudflow and flash floods. The Chitral District, located in extreme northern Pakistan is very prone to frequent and devastating landslides, mainly due to rough terrain, climatic conditions, climate change indicators, tectonics and seismic activities and anthropogenic activities on unstable slopes. This research focuses on slope stability analysis with the Limit Equilibrium Method computer program Slope/W and the Finite Difference (FD) method computer program FLAC3D under three working conditions i-e (1) Natural state condition (2) Rainstorm condition (3) Earthquake condition and a comparison of the analyzed result. The result shows that the deformed slope is slightly stable under natural condition but is unstable in rainstorm condition and under seismic load. The principal difference between these two analyses approaches is that the LE methods are based on the static of equilibrium whereas Finite Difference (FD) method utilize strength reduction method. The factors of safety obtained with two different approaches are compared and discussed in this research. The majority of published information is in regards to the slope stability analysis methods of Limit Equilibrium and Finite Difference and not the software packages themselves. Several studies have suggested that FD methods provide greater benefits than the LE method; however other studies have suggested that the simplicity of the LE method outweighs the complexity of FD methods. The study area is tectonically active region and tension cracks are present throughout the valley. Previously no such study was conducted in these areas, therefore, this research can be used for stability of slopes wherever is required. A comprehensive methodology adopted in the present research involves the geotechnical parameters investigation, numerical modeling with the help of MIDAS GTX NX, FLAC and Slope/W.