Geological investigation for landslide management: Keifang quarry area Mizoram

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Abstract

The landslide vulnerability of the state of Mizoram is already high due to lithology and structure like the other state of the northeast India. Landslides are the most common hazard in the state of Mizoram. Rapid development and the uncontrolled interaction with the nature are the reason for landslide in Mizoram The extensive mining activities and along the highways for the building and road materials appear to cause additional problems of landslides. So prominent landslide occurring in keifang quarry, Mizoram is studied. The study which indicates that geologically the rocks of keifang quarry are weak . On the basis of the studies a set of mitigation strageties have been suggested.

Keywords: landslides, geological surveys, stone quarrying and landslides.

1. INTRODUCTION

Mizoram state of Northeast India is a rugged terrain and forms part of the Patkai-Naga-Lushai-Arakan Yoma Hill ranges. The landslides is the most prominent hazard caused due to softer lithologies, intense deformation related to post drift kinematics, high degree of seismicities, complexly faceted geomorphic and slope morphometry, high degree of weathering and heavy rainfall. Such fragile geologica systems are also unmindfully exploited and modified for various developmental planning: all cumulative cause frequent landslides and land subsidence also. Though the landslide phenomenon cannot be totally eradicated, it can be minimized by duly understanding the controlling parameters and accordingly developing protective and predictive land management plans. In Mizoram, the mining for the construction materials also appear to trigger landslide in some areas.. Hence to understand this phenomenon and mitigate such landslide in the mining areas, a model study was carried out in keifang quarry whrere landslide occur frequently.

Keifang quarry is one of the most important quarries along Aizawl-champhai road section ,located 3 kms away from keifang village towards Champhai and 76 kms from Aizawl, The capital of the state. It lies in survey of India toposheet No.84A/14.

In addition to this major quarry slides, the phenomenon of landslide has increased in the recent past past due to large scale construction activities such as roads and the related deforestation and also, heavy rains during the monsoon periods. However this quarry is particularly taken up for the present study because the landslide that occur in Keifang quarry-road segment totally delink the eastern part of the region including Myanmar from the caoital city Aizawl .

The study mostly involves the understanding of the Geosystems and the dynamics of the area from geology, structure and geomorphology followed by geotechnical and geophysical investigations.

1.1 GEOLOGICAL SETTING

The Mizoram perching on the hills of Northeastern corner of India is flanked by Bangladesh on the west and Myanmar on the east and south.It has an area of 21089 sq.Km and has 630 kms long international boundary. North-eastern states are located in active seismic zone i,e. Zone V and Mizoram is one of them.

In addition to the complex lithological setting of the softer Tertiary sandstone and shales and the geological structures related to plate tectonics, the state do not favour for slope stability equilibirium due to high degree of weathering and heavy rainfall. These result that the state experiences landslide and land subsidence. Hence the instabilities of slopes are interrelated and controlled by the combination of complex geological setup,topography,meteorology,seismic factor. Anthropogenetic activities like unscientific quarrying and excessive utilisation of explosive for quarrying the building material and road metals.

1.2 **STUDY AREA**

The study area lies under Thingsulthliah Rural development Block in the state of Mizoram between 92° 56’30" to 93° 59’11"E and23°38’23" to 23° 44‘45" N in Aizawl district and falls under Survey of India topographical map No. 84A/12.

2. MATERIALS AND METHODS

The geological investigation was based on field study . Suunto compass was used for taking dip and strike amount and direction. GPSmap78sc (Garmin) was used for geo-graphical location.

2.1 Lithology

This quarry has been the main source of building materials for setting the Aizawl-Champhai road section. At the same time, it has been consistently causing hardships to public, travelling through this site located on the Aizawl-Champhai highway because of rock fall and rock blockage.

The area fell within Middle Bhuban formation having sandstone-siltstone-shale sequence as the major . The sandstone-silstone-shale alteration with thin layers of shale beds particulary along fracture/weak planes were the main lithological features of this quarry. The overburden materials were made up of approximately 5-10m thick loose sandstones, siltstone and shales. At about 100m before reaching the actual quarry site, two shales beds and sandwiched intraformational conglomerate beds were also found which is the peculiar nature of the rocks exposed in Keifang-champhai highway. There is also inferred an exposure of splintery olvine green shales at the site as well.

At about 20m distance from the quarry site, there was a massive light grey sandstone, fine to medium grained,containing specks of carbonaceous materials. Towards North Champhai from Keifang quarry at about 600m, there was an exposure of shale/silt stone which was dark grey in color and shale and siltstone were interbedded and hard with the thickness of 3m. The estimated potential of the quarry was about 729000 Cu.m as possible reserves. This quarry covered more than along the road and the vertical height was as high as 70m.

2.2 Structure

The important structural features in the quarry were the presence of three sets of joint with cross cutting relations. These joints set made the rock formations vulnerable to rockfalls. The other joints set was the bedding joint dipping towards southeast (100°) and played an important role in destabilizing the bed rocks. The joint spacing varied from inches to 10 feet. The general strike was N10°W and dipping 42° towards easterly and N10°W dipping 18° towards easterly. Further, towards Champhai, about 1 km from the rock exposure also show the strike of N10°W and the dip of 18° towards easterly.

3.Result and discussion

The general geological condition providing landslide vulnerability in Keifang quarry are as follows:

- The kinematically unstable upper rock slopes with major blocks dipping out of the slope.
- The adverse geologic structures such as three prominent joint sets.
- The joints planes acting as triggering zones when rain water passes through them.
- Blasting causing destabilization of rock particularly along the joint planes.
- The dipping of joint planes toward the road with the high dip.
- Rock excavation primarily from the bottom of the rock with the high dip.
- The presence of loose and fractured shale beds between the sandstone and siltstone beds.
- More weathering and loosening of shale.
- Sheet rocks and joint planes acting as smooth sliding surfaces.
- Filling of loose and fractured shale and clay material along the joint spaces

5. Conclusion

The Study revealed the following:-

1.The area falls under Tertiary sediments which are ,ostly composed of Arenaceous and Argillaceous sandstones and shale inter bedded of Bhuban formation

2. Keifang slide area falls witjin the middle Bhuban formation having composition of sandstone-silstone alteration with a thin layer of shale beds.

3.Keifang slide mainly due to unscientific extraction of boulders for road materials and due to high angle(78°-85°) cutting which resulted the upper rock to fall.

4.The adverse geological structures such as joint sets which are present in the formation exacerbated the excessive back break and rock fall. The joint planes acts as a triggering zone where rain water passes through them more during the rainy reason.

5.Along the shale beds, weathering and loosening of rocks are much more faster than that could have added unpredicted instability.

6. The joint space are filled with loose and fractured materials with shale and clay.This filling material decreases the chesion between the bed rock and resulting sliding phenomena, which are supported by heavy rain during monsoon-period.

7.High angle road cutting should be reduced to less than 45° by stripping benching methods, if so desired for further extraction of road materials.

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