Landslide Study at Tlungvel Quarry Areas, Aizawl District, Mizoram

Lalchhanhima[1], K.S. Rao[1], Laltlankima[1] and Lalbiakmawia[2]*

Abstract

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. Landslide vulnerability of Mizoram is already high due to lithology and structure. The extensive mining activities along the highways for road construction and building materials also cause one of major landslide along the highway of the state. The National Highway 54 passed through the study areas. The National Highway Number 54 is the most important road connecting Aizawl city and Northern, Southern and Eastern part of the State of Mizoram. The improper land use, lack of adequate drainage and toe removal for road widening are the major causative factors for the landslide. The present study deals with geological field investigations as well as recommendations in terms of preventive and remedial measures. On the basis of the studies a set of mitigation strategies have been suggested.

Keywords: *Landslide investigation, Bedding & joint intersection, Shear, Crumpling and mitigation*

1. Introduction

Mizoram state is a rugged region and forms part of the ranges of Patkai-Naga-Lushai-Arakan Yoma Hill. The landslides are the most prominent threat caused by softer lithologies, extreme post-drift kinematic deformation, high seismic degree, complex geomorphic faceting and slope morphometry, high weathering level and heavy rainfall. For different developmental planning, such fragile geological systems are also unmindfully exploited and modified resulting cumulative causes of frequent

[1] **Lalchhanhima, K.S Rao, Laltlankima,** Department of Geology, Mizoram University
[2] **Lalbiakmawia,** Govt. Zirtiri Residential Science College
* Corresponding Author Email: Chhan2007@gmail.com

landslides and land subsidence as well. Although it is impossible to completely eradicate the landslide phenomenon, it can be minimised by properly understanding the controlling parameters and developing protective and predictive land management plans accordingly. In Mizoram, in some areas, mining for building materials also tends to cause landslides. A model study was conducted in Tlungvel quarry, where landslides occur frequently, to understand this phenomenon and mitigate such landslides in the mining areas. Tlungvel quarry is located 60 km from Aizawl on National Highway 54 in the district of Aizawl.

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 does not favour for slope stability equilibrium 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 Regional Setting

The Aizawl to Lunglei highway was passing through the very steep hilly terrain of the village of Tlungvel, and massive sandstone beds were exposed by this hill. This sandstone bed above the highway has been mined by Border road task force/Public work department for decades for road and building construction, etc. Tlungvel quarry appeared to be the only source of good quality rocks for construction and road materials available in this area. At the same time, the equilibrium of the adjoining structure was deteriorated by the quarrying of rocks on the roadside, resulting in a structural break in the form of a rock slide from the above, endangering human life for rainy reasons. The rocks on the western side of the hill were exposed.

1.3 Study Area

The study area lies under Thingsulthliah Rural development Block in the state of Mizoram between 92° 51.33'E to 92° 52'19" E and 23° 35.81'N to 23° 36'07'N in Aizawl district and falls under Survey of India topographical map No. 84A/14 (Figure 1)

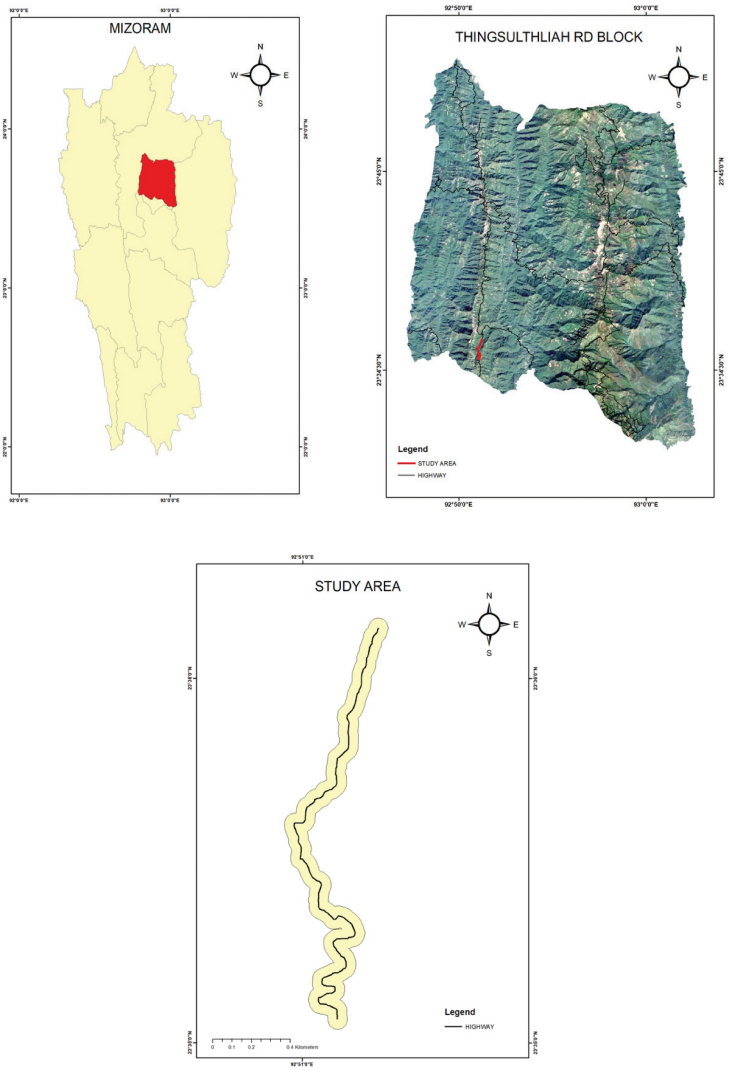

Figure 1: Map of Study Area

2. Materials and Methods

The geological investigation was based on field study and field work, Suunto compass were used for measuring dip and strike amount and direction. GPS map 78sc (Garmin) used for geo-graphical location.

2.1 Lithology :

One of the variables for landslides is lithology (Sharma et al.,2011). Mizoram's geology consisted of large rock flysch facies that comprised monotonous shale and sandstone sequences (La Touche, 1891). The area of study lies over the formation of Bhuban of the Surma Tertiary Age Group (GSI, 2011) and this formation was subdivided into Lower, Middle and Upper formations. Middle Bhuban is exposed, consisting mainly of argillaceous rock, and Upper Bhuban of Arenaceous rock is also exposed within the study area. The area consists of three distinct types of sedimentary rocks: sandstone, shale and silty shale. The main portion of the formation was covered by sandstone, which is highly compact with fine to medium grain having two distinct colors. The weathered sandstone horizons are coloured brownish, while the less weathered sandstones are coloured greyish. Three litho-units were developed purely based on the exposed rock types for the study area. These are called Shale-sandstone, Units of Silty shale and Sandstone-shale. Lithological units containing shale and siltstone are more vulnerable than the strong and compact shale units of sandstone to slide.

2.2 Structure :

In NE-SE, the bed rocks were trending with a dip of 60° to the northwest and south-east. At a daily interval of 2 metres, structures such as parallel cracks were also observed, which were very prominent, and a lot of cracks measuring from a few centimetres to 5 metres were noticed. In most of the exposed formations, shear zones were present.

The slide materials were mostly blocks of sandstone measuring between a few centimetres and 2 to 3 metres in diameter. Also seen as interbedded were shale and silty blocks. Among the rock types in the region, silty shale is the most susceptible unit to landslide.

3. Result and Discussion

The general geological condition providing landslide vulnerability in Tlungvel quarry as mention below:

Due to the presence of shear zones, the major slide of the region was caused by parallel joints and cracks and the resulting intrusion of rain water into the strata. There were amounts of springs (see page) and furthermore the slope angle was as high as 78-85 degrees and the entire formation was also rendered by the excavation of stones along the slope of the road cutting, toe loss which resulted in the area's sudden loss collapse/ rock falls. It was also found that there were no geological features such as faults. The region was located at the western extremity of the anticline of Tlungvel. The anticline axis and the ridges of the elongated hills were crisscrossing Seling and Tlungvel. In the eastern slope, the slide fell as the rock formations dipped westward, i.e., the bed rock dipped oblique to the hill slope. The general strike direction of the rock formation was N50° E dipping 15 towards southerly. No faults were observed for rock exposures in the quarry area, but there were two or more joints set running N 60 W dipping N70° E and N 60° E vertical dip. Mizoram receives heavy rainfall during May to October, under the influence of South West Monsoon. Heavy rainfall triggered the seepage induced through the primary (bedding planes) and secondary (joints and fractures) weakness zones or discontinuities, mostly at the Sandstone shale contacts. Excess rainfall led to the over wetting of the rocks and subsequent reduction of the retaining capacity. The seepage, leads to the reduction of the slope stability. At places the Sandstones are in wet conditions and due to continuous seepage from overlying Shales, blocks of sandstones are detaching.

4. Conclusion

The study revealed the following:

1. The study area falls under Tertiary sediments, most of which are Arenacious and Argillaceous sandstones and lower Bhuban formation shale interbedded.
2. The slide areas of Tlungvel quarry lie at the western limb of the anticline of Tlungvel.
3. The Tlungvel slide is mainly due to unscientific and unregulated excavation of road material boulders and high angle cutting that caused 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. Primarily from the bottom of the rock formation i.e. toe cutting, the rock excavation and extraction was performed. The rock fall was caused and intensified by this method of extraction and excavation. 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 .The existing quarry activities in the critical area and future quarry operation must be stopped
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.
8. Construction of retaining walls must be adopted in critical areas.
9. Drainage system must be constructed if necessary.
10. Area required soil conservation and prevention of extensive gullies.

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