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CASE STUDY OF COLLEGE VENG ROAD SECTION LANDSLIDE, AIZAWL, MIZORAM, INDIA

Rahul Verma

Department of Mining and Geological Engineering, BIUST, Botswana

Email: vermar@biust.ac.bw

Rahul Verma: <https://orcid.org/0000-0002-5207-316X>

ABSTRACT

Landslide is a very common feature along highways, roads and inhabited areas, in and around Mizoram. It is one of the most problematic hazards in the region. The present case of landslide, is in the 'College Veng' road section. It lies in the south eastern parts of the Aizawl town. This section is situated along the Sikulpuikawn-Bethlehem Veng road. The Coordinates of the "College Veng" slide are between $23^{\circ}43'28.56''/92^{\circ}43'28.28''$ to $23^{\circ}43'28.56''/92^{\circ}43'28.34''$.

The slide took place on 17th September, 2017, at mid night. The section had a relatively high amount of dip (48° - 50°), and has a lithology comprising of Shale and Sandstone intercalation. The total length of the slide section along the road was 75 feet, with a height of 25 feet.

After the critical observation of the incidence, the major aggravating factors were found to be that the heavy rainfall induced the top most shale bed to move down the dip slope. Improper sewage and subsequent mud erosion at the bottom of the shale layer, further accelerated the down slope movement of the slided block.

Keywords: Dip, Sewage, Rainfall, Erosion, Slide

Introduction

Mizoram is the extreme north eastern landlocked state of India, and shares 722 km long international borders with Myanmar and Bangladesh. The northern part of

Mizoram, shares domestic borders with Manipur, Assam and Tripura. Mizoram extends between $21^{\circ}56'N$ to $24^{\circ}31'N$ and $92^{\circ}16'E$ to $93^{\circ}26'E$ coordinates. The tropic of cancer passes through the state and bisects it into northern and southern half.

Aizawl, the Capital of Mizoram, is located in the northern part of the state.

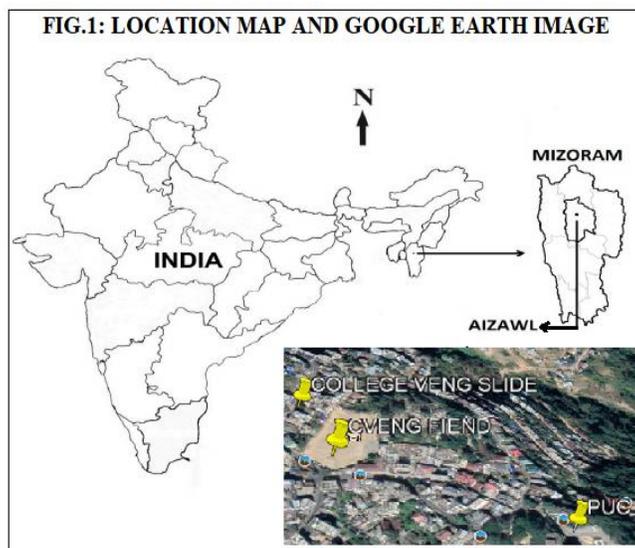
Aizawl city is situated on a ridge, varying in height between 800 m to 1188 m above mean sea level.

The Mizoram Hills (Lushai Hills) is an integral part of the “Indo-Myanmar mobile belt”. Geologically, Mizoram is a component of Tripura - Mizoram Mio-geosyncline and constitute a part of the ‘Assam - Arakan Geosynclinal Basin’ (Nandy, 1972, 1980, 1982). The dynamism in the vicinity of the Indi-Myanmar Mobile Belt, is the main source of tectonic stress in the region and frequent landslides are reflection of these regional stress. Tectonic movements within this mobile belt are reflected in the rocks in form of faults, joints and shear zones. The rocks of Aizawl belongs to the ‘Surma Group’. The rocks comprises of Sandstones, Shale, and Mudstones (Tiwari & Kumar, 1996).

Regional strike is N-S and dip of the beds are towards east in the northern part, while the dip is due west in the southern portion of Aizawl.

The region falls under tropical humid climate—moist tropical to sub-tropical under the influence of South West Monsoon. The summer temperature ranges between 20° to 30° C and winter temperatures range from 7° to 22° C. May to September are the rainiest seasons, with little rain in the dry season. The average annual rainfall is 253 cm.

The study section “College Veng” lies in the south eastern parts of Aizawl town and its exact coordinates are 23°43′28.56″/92°43′28.28″ to 23°43′28.56″/92°43′28.34″, with an elevation of 3007 ft. The section is located in Sikulpuikawn-Bethlehem Veng road. **Fig. 1** shows the exact location of the slide section (including Google Earth image).





Material and Method

For the present study area, direct investigation of the site has been done, with the consideration of the causative factors viz. lithology, primary and secondary discontinuities, land use cover and land use pattern, rainfall and seismicity.

The entire section was found to be 75 feet long and the attitude data have been collected at an interval of 1 foot. Rock samples and pictures have been taken as and where needed.

The data collected in the field were plotted on the online app “visiblegeology” to generate 2-D and 3-D stereographs and also the “Rose diagram”.

The prominent lithology was examined through the visible outcrops. On the basis of visible evidences, the prime causes of the slide were established.

Lithology and Structure

The lithology of the area of ‘College’ road section consists of Sandstone – Shale intercalation. The Sandstone layers are relatively thicker of the two, and the Shale layer is at the bottom (**Fig. 2A & 2B**).

Lithology or rock type is an important factor in controlling slopes stability; it controls the nature of weathering and erosion for a rock slope (Anbalagan *et al.*, 2008) and ultimately determines the type of failure. Ngaizel Landslide, Aizawl, Mizoram, India, is a fair example of structural control on failure. The multiple joint systems in the Ngaizel section are the main cause of wedge failure (Verma, 2014). Fan *et al.*, (2018) has also opined that physiographic factors have a strong bearing upon the probability of slides occurrence from their case study from the Kaoping River Basin Slide, Taiwan.

Nahid *et al.*, (2013) have worked on Probabilistic and sensitivity analyses of

effective geotechnical parameters on rock slope stability, in their case study of an urban area in Northeast Iran.

It can be observed that the rocks dip uniformly due east, varies from 48° - 50° with an elevation of 3007 feet above mean sea level. At the base of the section, irregular and thinly bed of shales are visible.

Result and Discussion

The ‘College Veng’ landslide is a case of slope instability (SI), triggered by the combined effect of individual inherent parameters viz. lithological dissimilarity, moderately high amount of dip and external parameters like excess rainfall. Most of the area is in damp condition which makes the soft sandy shale loosening and altering the slope stability. Heavy rainfall, has induced the distortion of massive rock faces by weathering activity.

Both ‘2-D’ and ‘3-D’ stereo-plots clearly exhibit the easterly disposition of the rocks in the concerned section (**Fig. 3A & 3B**).

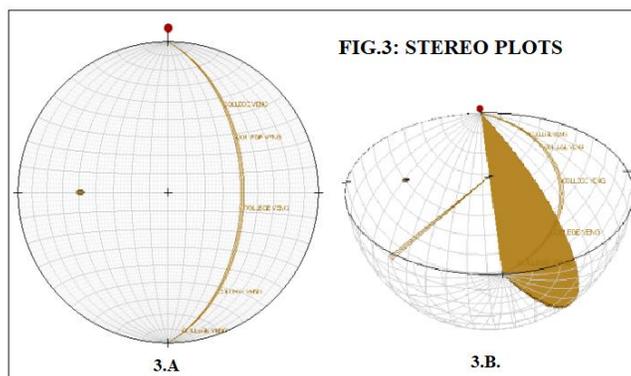
The similar disposition is confirmed by the “rose diagram” (**Fig. 4**). The exact direction of the slide, actually observed in

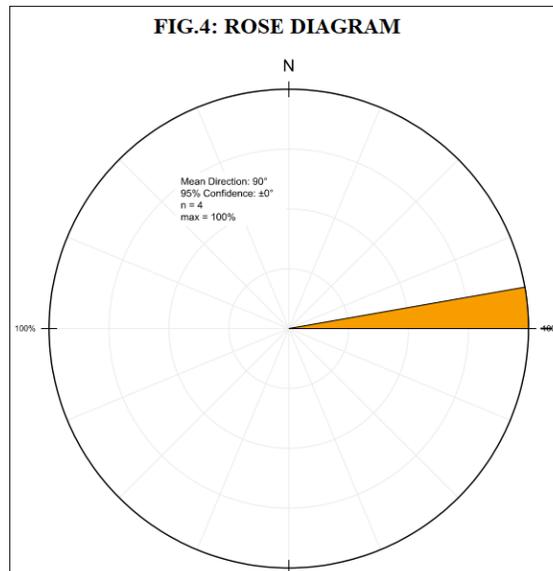
the section, also confirms the east ward down slope movement.

Since there are many houses on top of the slope (**Fig. 5A**), the combined overload of the buildings and the over wetting of the subsurface due to sewage, further aggravates the situation. Due to improper drainage of surface water runoff and poor sewage system, water percolates immediately through the top sandy soil and the whole area become water bearing horizon in the rainy season, which leads to the loosening of the Shale layer. By virtue of these factors, the higher parts of the slope above the water bearing horizon (top soil) become less stable and prone to subsidence and finally collapse in the dip direction, under the influence of gravitational force (**Fig. 5B & 5C**).

Similar mechanism of sliding was observed in the case of Laipuitlang slide though it was on a very large scale and had many causalities (Verma, 2014).

Lee *et al.*, (2013) have carried out numerical modeling work as part of a forensic investigation on a catastrophic roadside due to dip slope failure in Taiwan. It may be considered as the similar phenomenon.





Conclusion and Recommendation

The slide at the College Veng, eventually, took place due to combined effect of human activities and the natural factors. Human settlements on the risky slope, improper drainage and sewage of rain and domestic water, lithology, structure, attitude of the beds and above all the excessive rainfall, happened to be the major factors of the slide.

To avoid such incidences, situation demands immediate preventive measures such as meshing, filling and grouting, treatment of the discontinuities and improvement of in the drainage and sewage systems. Social counseling of people is also required to promote awareness about landslide hazard and demolition of high risk building and evacuation of urban population settlements at the top.

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Web Resources:

www.googleearth.com

<https://app.visiblegeology.com/stereonetApp.html>