

Landslide Hazard in Mizoram: Case Study of Laipuitlang Landslide, Aizawl

Verma, Rahul

Department of Geology, PUC, Mizoram University, Aizawl – 796 001, Mizoram, India

Abstract: *The Mizoram state is located in the Northeastern India, bordered to the east by Myanmar and to the west by Bangladesh. It has an area of about 21,087 sq. km. It lies between latitudes 21°56' N and 24°31' N and longitudes 92°16' E and 93°26' E. Aizawl (92°60' E longitude and 23°58' N Latitude) the capital of Mizoram, is located in the northern part of the state. Mizoram is one of the most landslide prone zones of the country. The state suffers huge loss of life and property, due to landslides, every year. During this decade, Aizawl town has witnessed more than 300 deaths and damage of equal number of houses. May 2001 was the year of severe disasters in Mizoram State. The present case study is an attempt to evaluate the causes of the "Laipuitlang" landslide in Aizawl Township, Mizoram that occurred on 11th May, 2013. Along with heavy loss to the more than 15 buildings, this landslide has taken 17 lives. The "Laipuitlang" area is one of the most populated localities in the Aizawl town, the capital of Mizoram state. It is situated on the hill called "Laipuitlang", in the northern part of the city. The coordinates of Laipuitlang Slide, are 23° 44'41" and 92°43'16". In the case of the "Laipuitlang" landslide, the prime cause of failure has originated due to the geological set up of the area, in combination with shear negligence of urban planning, geological site considerations and hazard estimation. The massive sandstone bed above the shale, forms the prominent lithology in the study area. The massive sandstone and shale beds are steeply dipping (around 40o-70o) from the Laipuitlang Peak, towards the "Ramhlun Venglai" road section. Presence of vertical joints has also played some role in destabilization. Improper drainage and sewerage system has led to large amount of water penetration in the foundation of the PWD building which was located in the Crown region. To worsen the situation, prior to the landslide, few days of high rainfall has led to the minimization of the cohesive strength in the basal part consisting of incompetent shale. The shale began to behave as loose soil after weathering. Ultimately the whole building slid down slope along with the shale foundation and buried 10 houses and a church building beneath. Unfortunately, the administrative lacunae, delayed the demolition and this sheer administrative ignorance, proved to be fatal.*

Keywords: Slope Failure, Shaly foundation, Seepage, hydrological condition; retaining capacity, Weakness zones.

1. Location and Approach

Mizoram is the southernmost state among the north eastern states, in the territory of India, sandwiched between Myanmar to its east and Bangladesh to its west. Aizawl, the capital of Mizoram, is located in the northern part of the state and the present study site is located in the northern part of the city, bearing coordinates 23° 44'41" and 92°43'16", and is one of the most densely populated parts of the town. Exact location of study site on the map of India, the Google Earth location along with Google map, is shown in Figure.1.

2. History of Landslides in Aizawl

Within Aizawl district, several severe landslides have been recorded during the last two decades. In 1992, landslide in the stone-quarry at South Hlimen locality claimed 66 lives (Tiwari & Kumar, 1996). 17 houses were destroyed. In 1994, Aizawl Venglai, Ramthar and Armed Veng localities were sinking, that caused severe damage to 65 houses. In 1995, there was a long-line crack at Hunthar locality alongside Aizawl to Sairang road (National Highway 54). In May, 2011, massive "Ngaizel Landslide" stranded the national highway for many days. (Verma, R., 2012, 2013).

GIS environment using ARC/INFO (9.3 version) has generated a "Landslide Hazard Zonation map" based on the study of the data source from Indian Remote Sensing Satellite (IRS-P5) stereo-paired Cartosat-I imagery having spatial resolution of 2.5 m and Indian Remote Sensing Satellite (IRS-P6) LISS III data having spatial resolution of 23.5 m. According to the studies, the entire Aizawl region

has been classed into "Very High Hazard Zone (Lallianthanga and Lalbiakmawia, 2013).

3. Causative Factors in the Failure Mechanism of Laipuitlang Slide

3.1 History

The very location was used to be a "sandstone Quarry" in the past. The same location has a history of huge rock slides 1957, 1968 and 1969. Indications of the disaster were seen in 2010, when several crack lines on the wall of a five stories house developed.

The geological map of the slide section (Fig.2), presents a clear picture of the disposition of rocks before the landslide occurred. The top sandstone layer is underlain by shale and siltstone. The PWD building was located on the top layer. The strata is generally high dipping with the dip amount varying from 40° to 70° as one moves up dip. The slope morphology is presented in Figure.3.

3.2 Triggering Factors

Major triggering aggravated in September, 2012 after heavy down pour of 328.9 cms. The rock basement, retaining wall and the walls of the Public Works Department (PWD) Building, which was located in the Crown position developed cracks. The cracks began to widen due to the continuous seepage and began to affect the base of the building that is a sandstone- shale junction. From all possible weakness zones, the continuous seepage began to spread down dip. Hydrological conditions before the slide,

has been presented in Figure.4. In the preliminary disaster prevention measure, the building was vacated and also the demolition order was issued. Unfortunately, due to administrative delay, the building could not be demolished timely and the load of the building caused the slide and collapsed, creating a big disaster.

3.3 Landslide Mechanism in the Study Site

Figure.5 sketches the actual mechanism of the very slide. Fig.5 (A) shows the picture before the slide. Top sandstone layer on which the PWD building is situated, can be seen. Excessive seepage along the weakness zones badly damaged the base of the top layer and underlying shale bed. The weakened foundation, under the combined influence of the heavy load of the building and steep slope, lost the retaining capacity, and slid down, thus overriding another building which was located in the toe position. All collapsed structures slid further towards the Rahmlun Venglai section and caused fatal damage to life and property. Fig.5 (B) shows the morphology after slide. It can be marked that, after the slide, the top sandstone layer has almost vanished except a small notch along the left flank of the slide. For ready reference, Fig.6 shows the Pre and Post slide pictures of the slide location. Different views of the slide are shown in Figures 7 & 8.

A summary of the main causative factors:

- a) The shaly foundation and the load of the P.W.D. building.
- b) Accumulation of erosion generated soil debris, along the bedding plane on the right flank.
- c) Loose soil on the southern edge of the bedding plane.
- d) Presence of sub vertical joints to impart weakness to the slope.
- e) Heavy rainfall before slide.
- f) Leakage of PHE pipe lines causing active damage to the shaly foundation.
- g) Large scale penetration of seepage into the weaker shale foundation.

4. Damage Estimate

The slide at Laipuitlang took place at midnight between 2:30a.m-3:00a.m. At the time, most of the resident were sleeping, that is why a high number of human casualties are recorded. 17 persons lost their Life 8 person injured. Property damage includes 7 RCC, 8 Assam type houses and

a part of the local church. Many vehicles were heavily crushed under the slide (Fig.9).

5. Conclusion

The Laipuitlang landslide is a case of slope instability, resulted due to combined effect of several factors like excess rainfall, shaly foundation, seepage through primary and secondary weakness zones like bedding intersections, sub vertical joint, minor fractures and through loose soil debris. Sheer negligence of Urban Planning and administrative control, has been equally responsible for this disaster. Strict geological considerations are badly needed with the urban planning. Site selection, improvement in the drainage and sewage, people's awareness about landslide hazard zone, are the need of the time, in order to avoid any further loss of life and property due to landslides.

Acknowledgement

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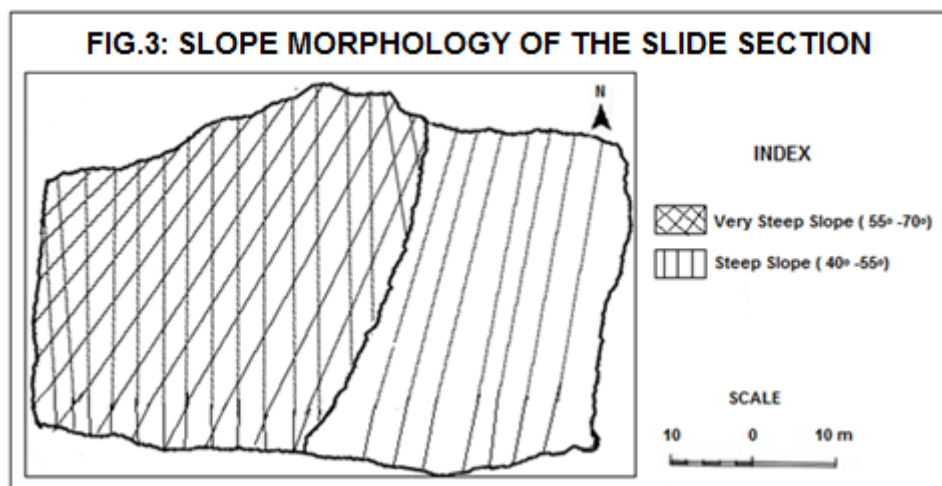
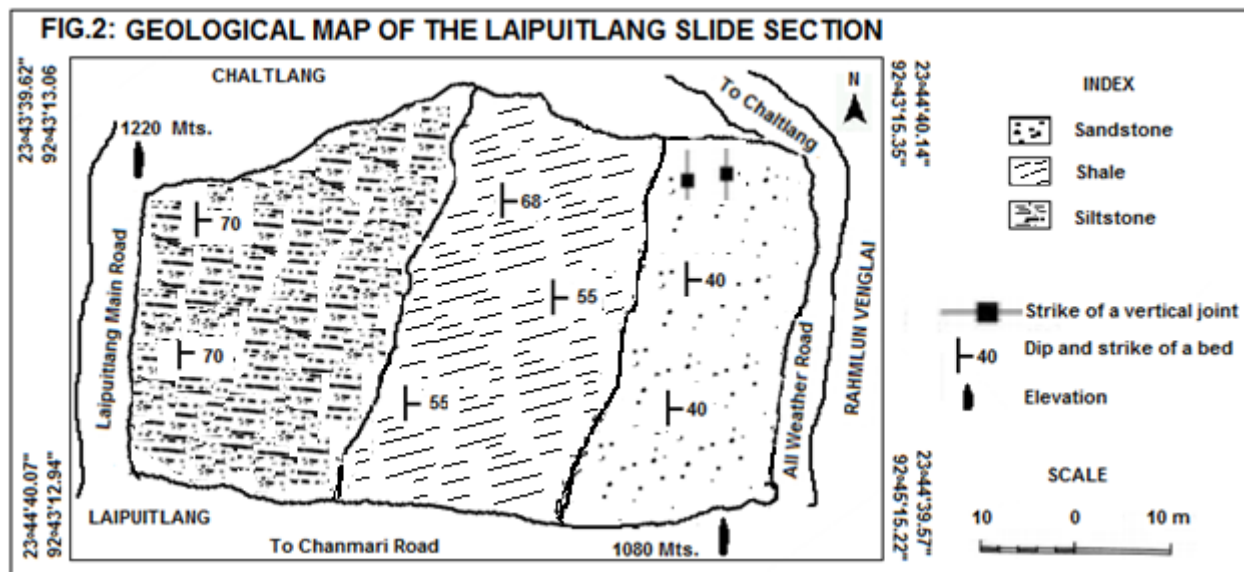
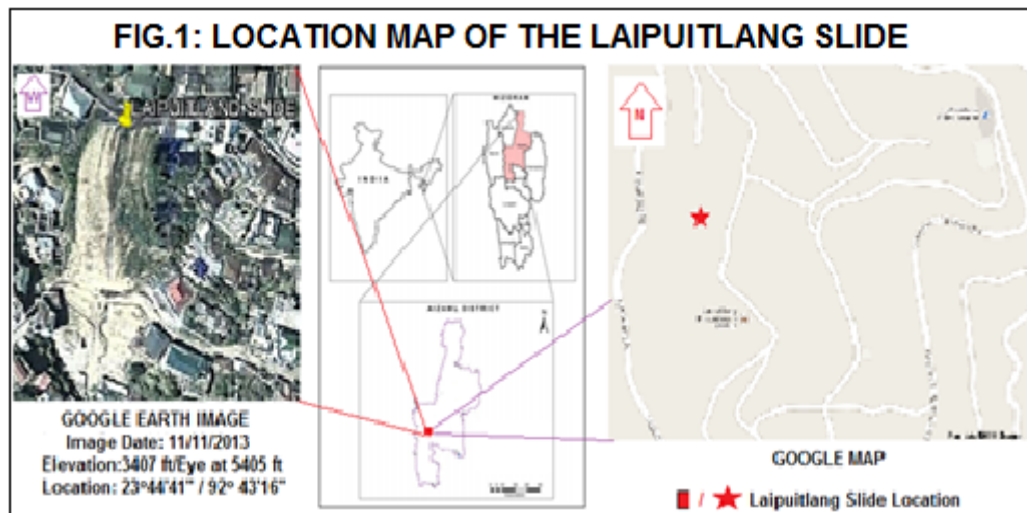


FIG.4: PRE DISASTER HYDROLOGICAL CONDITIONS OF THE SECTION

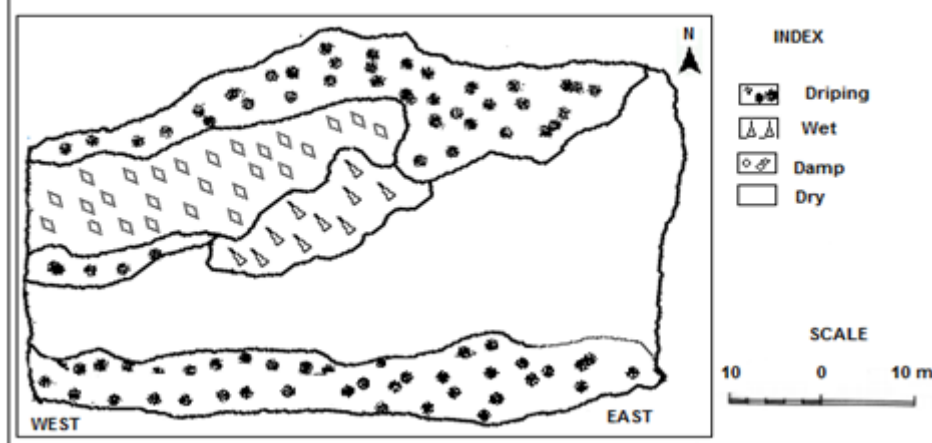


FIG.5: COMPARISION OF PRE AND POST DISASTER MORPHOLOGY

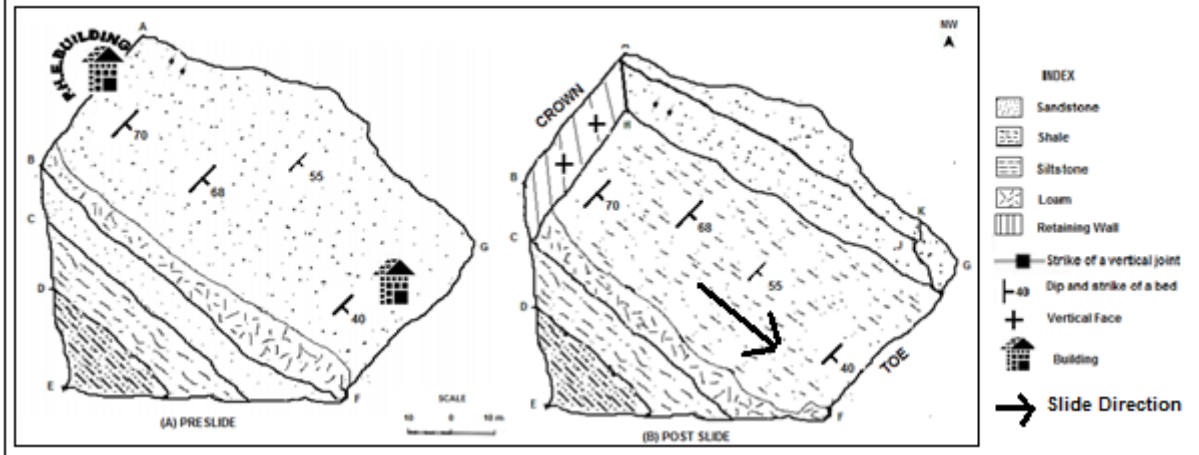


FIG.6 : PRE AND POST SLIDE SCENARIO

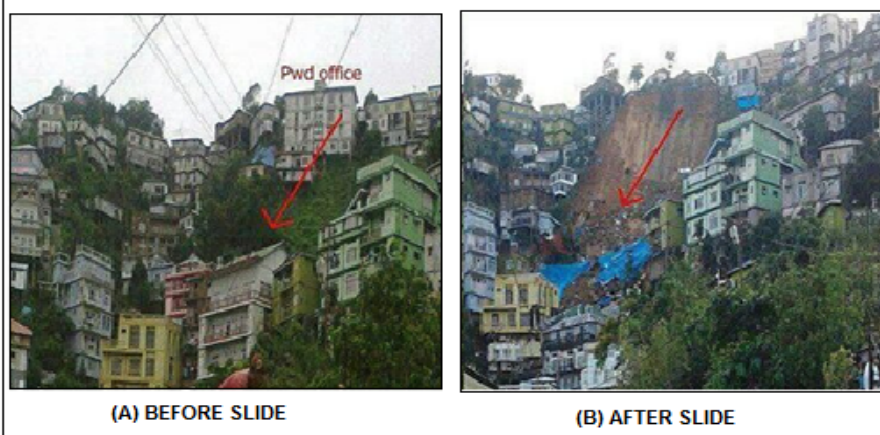


FIG.7: PANORAMIC VIEW OF THE LAIPUITLANG SLIDE



FIG.8 : DIFFERENT VIEWS OF THE SLIDE



FIG.9 : DAMAGE DUE TO LANDSLIDE

