

## **A NOTE ON THE POST DISASTER LANDSLIDE INVESTIGATION OF LUNGLAWN LANDSLIDE IN LUNGLEI TOWN, LUNGLEI DISTRICT**

**By**

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As per the reports from DGM office, Aizawl and media reports from “The Times of India” dated 06.06.2018, a massive landslide occurred in Lunglawn locality of Lunglei town causing death of 10 persons. The Post Disaster investigation of the landslide was taken up on priority basis on 14.06.2018 as per the Office Order no. 266/Office order/Cir/SU: T&M/TC/2018 dated 7<sup>th</sup> June, 2018 from Geological Survey of India, State Unit: Tripura and Mizoram, Agartala.

The Lunglawn landslide (Lat: 22°52'24.81"N; Lon: 92°45'21.43"E) is located in Lunglawn locality, Lunglei town, Lunglei district which is 165 km towards south of Aizawl. The area falls in SOI Toposheet no 84 B/04. The slide occurred in the south eastern part of Lunglei town towards the eastern part of the ridge. As per the discussion with Mr. Lalramngheta, a resident of Lunglawn and one of the first responders after the disaster, the landslide occurred on 4<sup>th</sup> June 2018 at 18:30 hrs. There was heavy rainfall during the whole day prior to the occurrence of the landslide. One pucca house belonging to Mr. Vanlalpeka was entirely destroyed by debris of landslide which buried the house along with its occupants. Immediate rescue operations by neighbours and the local NGO (YMA) managed to rescue 4 persons out of the 14 members of two families residing in the buried house, while the other 10 lives could not be saved. The landslide is around 15 meters in length and 18 meters in width. It is a small but devastating landslide due to its rapid movement and time of occurrence.

The landslide has occurred on the south-eastern slope of the NNW-SSE trending ridge, occupied by settlement was surrounded by moderate to sparse vegetation. The houses are mostly built on extensively cut slopes. Average slope of the area is 30<sup>o</sup>.

The particular slope on which the landslide occurred is covered by older compacted debris and 2 to 3m thick younger loose debris derived from extensive slope cutting and dumping of waste material during building of an older house on the right portion of the crown and a recent building on the left portion of the crown. The dimensions of the landslide are 15m length x 18m width x ~ 3 m depth.

The landslide crown is close to foundation of the buildings and the new building has thus become vulnerable. The landslide has also destroyed a part of the retaining wall meant to protect the foundation of the older building. Unfortunately the house below the landslide was located in the zone of accumulation and was completely buried by the debris material. The debris from the landslide also damaged about 20m of a footpath towards the toe of the slide.

No cracks are seen on the crown and either flank of the landslide to the extent of 4-5m. The area exposes sandstones, siltstones and shales of Upper Bhuban Formation of Surma

Group which are moderate to low in strength. These soft and highly weathered rocks are covered by thin veneer of in-situ soil.

**Geoscientific Causes:** The main causes of the landslide are as follows.

1. The bedrock (Shale) is highly weathered, while the slope is governed by the dip of the bedrock which is  $40^\circ$  towards south-east direction.
2. There was extensive slope cutting at the crown of the slide during the construction of the building at the crown. The excavated materials were dumped on the steep slope without any retaining wall and just resting on the slope behind the house. The older house was also constructed by extensive slope cutting and dumping of excavated materials on the slope. However, the excavated material from the site of older building was more consolidated and these were used as fill material to develop a terraced kitchen garden with a retaining wall.
3. Continuous and heavy rainfall for one whole day caused extensive surface runoff which destabilized and triggered the movement of the loose, unconsolidated dumped wastes resting on the steep slope without any protection works.

**Recommendation:**

1. Keeping the above observations in mind, it is strongly recommended to provide a suitable retaining wall in the affected zone of nearly 20 m length to be founded preferably on the bedrock (Fig. 3) with proper weep holes at the toe of the landslide which will restrict the further movement of the slope material.
2. Lined contour and cross drains needs to be constructed in the area to effectively drain the surface runoff away from the affected zone and particularly along the road at the crown of the slide (Fig. 3).
3. Proper lined drainage and pipes to guide domestic run off and runoff from the roofs of the houses to avoid further damage to the foundation on the backside of the houses.
4. Slope easing by construction of benches with proper retaining and breast wall on the affected slope with adequate drainage arrangement.

**PHOTOGRAPHS AND SKETCH**



Fig:1. Photos of various parts of the slide.



Fig:2. Photos of the run out of the landslide.

**Annexure I: 42-Point detailed geoparametric attributes of the landslide.**

1	Slide	MIZ/LU/84B/13/2018/01
2	State	Mizoram
3	District	Lunglei
4	Toposheet	84 B/13
5	Name of the slide	Lunglawn landslide
6	NH/SH/Locality	LunglawnVeng, SE of Lunglei town.
7	Latitude	22° 52' 24.81" N
8	Longitude	92° 45' 21.43" E
9	Length	15m (approx)
10	Width	18m (approx)
11	Height	10m (approx)
12	Area	270sq m (approx)
13	Depth	~ 3 m
14	Volume	510 cu. m
15	Run out distance	>50m
16	Type of material	Debris
17	Type of movement	Slide
18	Rate of movement	Rapid
19	Activity	Active
20	Distribution	Retrogressive
21	Style	Single
22	Failure mechanism	Shallow translational failure
23	History	Slight movement due to earthquake was observed on the slope on the left flank of the slide on 2014. The present landslide movement happened on 06.06.2018 at 6:30pm.
24	Geomorphology	Highly dissected slope.
25	Geology	The area exposes sandstones, siltstones and shales of Upper Bhuban Formation of Surma group which is highly weathered. The rocks themselves are very soft and at highly weathered.
26	Structure	S <sub>0</sub> -NNE-SSW, 40°→SE.
27	Landuse/landcover	Thick vegetation
28	Hydrological	Wet

	condition	
29	Triggering factor	Rainfall
30	Death of persons	10 persons
31	People affected	4 survivors, now homeless.
32	Livestock loss	Nil
33	Communication	20 m stretch of a kachha road damaged by debris from run out.
34	Infrastructure	One pukka house destroyed by the debris. The houses at the crown has severe damage to their foundation.
35	Agriculture/ Forest/ Barren	Nil
36	Geoscientific process	<ol style="list-style-type: none"> <li>1. The bedrock (Shale) is highly weathered wherein nearly 2 meters thick soil has developed on gentler slopes above the crown (Photo 3).</li> <li>2. The dip of the bedrock is 40° towards south-east direction which is also the direction of the slope. (Photo 4).</li> <li>3. There was extensive slope cutting at the crown of the slide during the construction of the building at the crown. The excavated materials are dumped on the steep slope and just resting on the slope behind the house. The older house was also constructed by extensive slope cutting and dumping of excavated materials on the slope. However, the dumped wastes from the older building were more consolidated and the dumped wastes were benched to form a terraced kitchen garden with a retaining wall.</li> <li>4. Continuous and heavy rainfall for one whole day caused surface runoff of rain water to destabilize and then trigger the movement of the loose, unconsolidated dumped wastes resting on the steep slope.</li> </ol>
37	Remedial measures	<ol style="list-style-type: none"> <li>1. A retention wall (Fig. 3) with proper weep holes has to be constructed at the toe of the landslide which will restrict the further movement of the slope material. The wall should be founded over hard bedrock. Dimension (L * W * H) = 20m * 1.5m * 3m.</li> <li>2. Lined contour and cross drains needs to be constructed in the area to effectively drain the surface runoff away from the affected zone and particularly along the road at the crown of the slide (Fig. 3).</li> <li>3. Proper lined drainage and pipes to guide domestic run off and runoff from the roofs of the houses to avoid further damage to the foundation on the backside of the houses.</li> <li>4. Slope easing by construction of benches with proper retaining and breast wall on the affected slope with adequate drainage arrangement.</li> </ol>
38	Remarks, if any	Though the slide is a small slide, due to the extremely rapid rate of movement and the time at which it occurred i.e. 6:30 pm which is dinner time for most families in Mizoram, it has taken the lives of 10 people.

39	Photos, sketch of the plain and section of the slide	<p>Fig. 1. Before occurrence of landslide.</p> <p>Fig. 2. After occurrence of landslide.</p> <p>Fig. 3. Recommendations.</p>
40	Summary	<p>The Lunglawn slide, though it is a small slide is a devastating slide. It has caused the death of 10 persons and left the surviving 4 persons homeless. The landslide is a purely anthropogenic landslide because had the debris from excavations for building a house been disposed off properly, the slide could have been prevented. It highlights the need for awareness in the Mizo society to practice safe and scientific building practices and protection of slopes.</p>
41	Landslide Category	Category-II
42	Pdf	Enclosed