NOTE ON POST-DISASTER PRELIMINARY GEOLOGICAL STUDY OF THE LANDSLIDE AT NH-102A, NEAR LEITING VILLAGE, UKHRUL DISTRICT, MANIPUR

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Abstract

On 14th June, 2018, a landslide with an estimated dimension of 70m length x 55m width x 60m height was recorded on NH-102A, at about 1.5 km south of Leiting Village. The site is located at Lat. 24.9252N and Long. 94.3371E in the SOI toposheet no. 83 L/05. The landslide is a reactivation of an old landslide that had occurred due to saturation of thick pile of weathered rock and debris by antecedent heavy rainfall, resulting in a reduction of shear strength and cohesion of the poor slope forming material. Moreover, the presence of steep hill slope (average slope is about 45°-50°) and highly permeable weathered rock also facilitated the landslide. The landslide measuring an approx. 70m length x 55m width x 60m height is categorized as debris slide.

The investigated landslide on NH-102A, at about 1.5 km south of Leiting village, is approachable through NH-102A from Ukhrul district of Manipur. As per information gathered from local people this land slide occasionally disrupts the vehicular movement.

Physiography & Drainage

The topography is youthful one represented by (1) high ridges rising to a height of 1438 m above MSL, (2) steep gradient streams and water courses actively eroding the rock carving deep gorges (3) 'V', shaped valleys. The main streams join the Makhang Khong River. The strike parallel ridges trend in NE-SW direction and forms the major water divide. The highly resistant sandstone forms high ridges, while the less resistant shale and siltstone occupy the lower elevation and at places form flat topped hills. The Makhang Khong river flows along the strike of the beds in the south eastern part of the area. The overall drainage pattern is structurally controlled. Thus the present day topography is a reflection of lithology and structure. The drainage patterns of the area are sub-dendritic to sub-parallel type and are mainly controlled by regional joints and fault system.

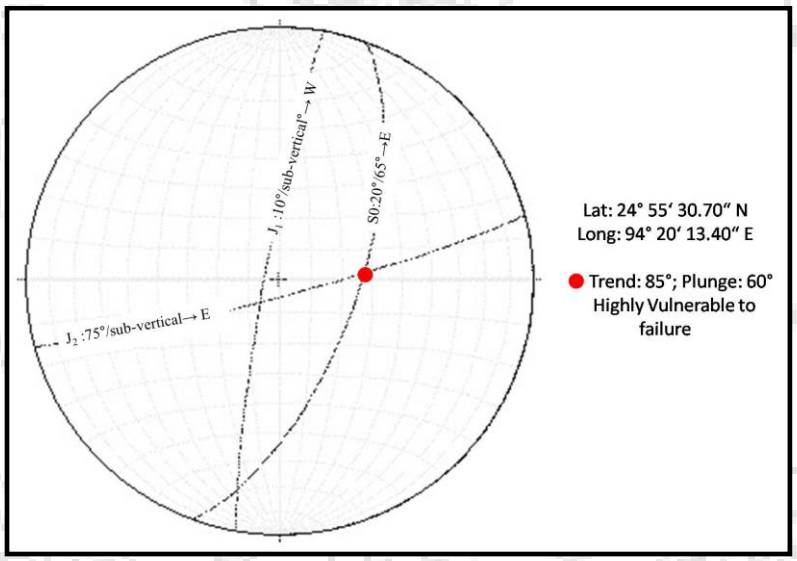
Site Geology

The landslide debris is derived from shale and sandstone of Disang Formation which are highly weathered, fractured, jointed, sheared and fragmented. The in-situ soil or overburden material ranges from 0.5 to 2m in thickness. The disintegrated shale and sandstone Disang

Formation are strewn on the slopes due to less of content of cohesive soil. The soil cover ranges from 0.5 to 2m in thickness and slided portion lies within soil cover without exposing the concealed rock of Disang Formation.

Slide Morphometry & Material

Heavy and frequent rainfall coupled with the lack of proper drainage systems has resulted in development of pore pressure within the lithic arenite material of Disang Formation. An important feature delineated within the slide is the network of rill erosion running parallel-sub parallel to the failure plane of the landslide (Photo 1, Photo 2). Secondary concave failure planes are traced for an approx. 5-8 m in length. The depth of the failure plane is more (>5m) which involves a large volume of slided material and it is a deep translational failure. A few prominent minor local scarps of variable length occurring within the body of the landslide have also been delineated. These minor scarps are indicative of secondary or later stage movements that have occurred subsequent to or in isolation to the large scale failure of the landslide which may be described as secondary or subsidiary scarps. The slide material is of soil type in nature and it is loosely compacted or bounded due to presence of less clay percentage.



Failure Mechanism of the Landslide

The visual estimation of the slide along the scarp has indicated 70m length x 55m width x 60m height. Based on the disposition of the slide debris as well as the visually estimated overburden thickness, a planer slide along secondary developed interface has been interpreted towards the up side of the landslide body. The primary triggering factor of the landslide is the rainfall. A combination of factors like steep slopes (average 47°), presence of weak rockmass comprising weathered splintery shale, percolation of water during incessant heavy rainfall leading to saturation of the poor slope forming material and a resultant reduction in the cohesive strength

as well as the internal friction angle, rill erosion, etc., appears to be the causative factors in the initiation of the landslide.

Field-based Stability Assessment

In addition to the above, a field-based perspective stability assessment was carried out to ascertain the probable zones of future failure as well as identify the stable zones, keeping in mind the apprehension regarding the stability of the NH-102A road and in case of further reactivation of slides. Field-based stability assessment of the landslide prone area situated on the immediate upslope of the road has been assessed based on the following:

1. The rock exposed adjacent to this slide comprises thinly bedded shale and siltstone bands of Upper Disang Formation which represents a weak rock mass.
2. Lack of a lined hillside drain along the road leading to percolation of surface runoff into the weak rock mass.
3. Presence of unguided down slope flow of surface runoff.
4. The existing road is to serve for the local need of transportation from Ukhrul to Phungyar Village. The dumped material has been removed by the local authority.

Considering the above prevalent conditions as well as the inherent rock mass properties, it is apparent that slide of rock debris from the effected slope can reactivate in near future causing more damage to the existing road. However, continuous observation/monitoring of the same especially towards upslope of the road for detection of any signature of slope instability are advised.

The stability of this slide will largely depend on the successful control of any further seepage/percolation of surface water along the slope. In addition, further activity towards the middle of the landslide body, particularly along the developed secondary planes on the upslope of the rock debris cannot be ruled out during any unprecedented/adverse hydrological conditions. Any such activity will evidently lead to sliding of the debris which will in turn lead to blockage and damage of the road.

Recommended remedial measures

1. Since the road segment appears to be constructed over the filled dumped material hence it would be advisable to provide gabion wall on the hill side of the road.
2. Proper lined contour drains are recommended to channelize the surface runoff away from the slide zone and to prevent the percolation of water in substratum.
3. Immediate removal of debris material.
4. Warning sign board may be installed on either side of the slide zone to caution the commuters.

42- Point detailed geoparametric attributes of the landslide

1	Slide	MN/UKH/83L05/2018/0001
2	State	Manipur
3	District	Ukhrul.
4	Toposheet	83 L/05
5	Name of the slide	Landslide at 1.5 km South of Leiting Village
6	NH/SH/Locality	NH-102A.(Near Leiting Village)
7	Latitude	24.9252N
8	Longitude	94.3371E
9	Length	70m
10	Width	55m
11	Height	60m
12	Area	3850 sq. m
13	Depth	6m
14	Volume	23100 cubic meter
15	Run out distance	-
16	Type of material	Debris
17	Type of movement	Slide
18	Rate of movement	Moderate
19	Activity	Active
20	Distribution	Enlarging
21	Style	Multiple
22	Failure mechanism	Deep translational failure
23	History	Reactivated
24	Geomorphology	Escarpment
25	Geology	Dominantly weathered Shale of Disang Formation is exposed in the area.
26	Structure	-
27	Landuse/landcover	Thick vegetation
28	Hydrological condition	Dripping
29	Triggering factor	Rainfall
30	Death of persons	Nil.
31	People affected	Nil.
32	Livestock loss	Nil.
33	Communication	Partial damage to NH 102A
34	Infrastructure	-
35	Agriculture/ Forest/ Barren	Forest.
36	Geoscientific causes	1. Weathered splintery shale 2. Rill erosion 3. Debris material 4. Heavy rainfall leading to excessive water percolation to the ground.
37	Remedial measures	1. Slope easing 2. Proper drainage at toe 3. Gabion wall construction (80m length x 3m height x 1m width)
38	Remarks, if any	Partial damage and narrowing of the NH 102A in the slided area. Natural Landslide facing 174˚.
39	Photos, sketch of the plain and section of the slide	Given in the report

40	Alert categorisation	Category-I
41	Summary	-
42	Pdf	-

Photographs

Photo 1: View from left flank of the landslide

Photo 2: View from right flank of the landslide

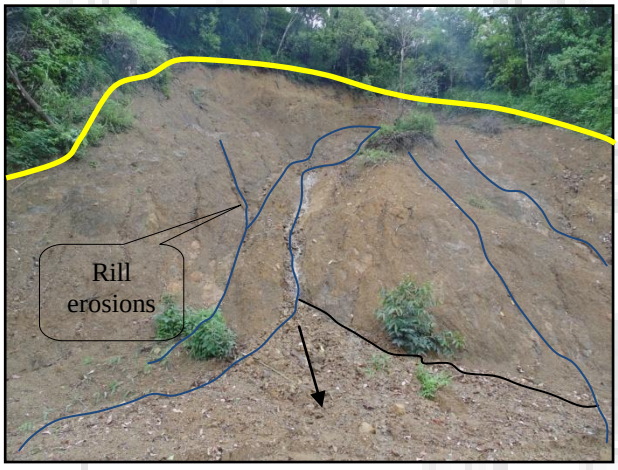


Photo 3: Front view of the landslide (Photograph taken in upslope direction)

Photo 4: Dumped materials of the landslide (Photograph taken in downslope direction)