

Inspection note on the recent visit to Machong Landslide, Pakyong, East District, Sikkim on 12/07/2017

By

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A large rock slide incidence occurred at 8.30 hrs (approx.) on 10.07.2017 at Pachey area near Pakyong Town along Pakyong-Machong Road in East District, Sikkim. (Fig. 1). The failure was initiated at around 14.00 hrs on 09.07.2017 which became active and failed at around 8.30 hrs on 10.07.2017. The landslide (zone of depletion) is located at a location having coordinates - 27°14'29.2" N and 88°36'24.5" E and the entire landslide area falls exactly at the boundary of the Survey of India Toposheet No. 78A/12. A visit was made to the affected area and field investigation was carried out on 12.07.2017 to assess the landslide and evaluate the causative factors by a team comprising of P.K. Shrivastava, Suptdg. Geologist, Lopamudra Bhol, Senior Geologist, Niranjan Kumar & Nirmalya K. Lenka, Geologists, Geological Survey of India, North Eastern Region, Landslide Hazard Division, State Unit: Sikkim visited the affected area.

Preliminary field observation confirmed that the Machong landslide was characterised by a very rapid sliding movement along with fast fall of bedrock material along a steep slope ($>45^\circ$; refer Fig. 3), due to the action of gravity, which resulted accumulation of huge amount of rock debris. The dimension of this landslide is huge, having length of about 200m, width of about 120-150 m, height of about 100m, total run out distance of about 200m. The depth to failure surface being more than 5 m (deep seated). The landslide is enlarging in nature so far as its distribution is concerned. Observing the nature of movement, rapidity and material moved, this landslide can also be termed as rock fall/slide, which are quite common mostly in higher altitude areas of the Himalayas. During the active movement of this landslide, the failing landslide also generated a huge impact of moving rock boulders and a relatively moist debris. The type of overburden is highly weathered rock and soil having thickness of 1-3m. The rocks are highly fractured. A prominent discontinuity surface, probably a continuous joint plane has also been observed. The landslide is active, enlarging, multiple and deep translational in nature. The surrounding area of the landslide exposes with phyllite intercalated with quartzite of Daling group of rocks having the following trends: Foliation: $N50^\circ E/58^\circ \rightarrow SE$, Joint Planes [F1: $78^\circ \rightarrow 28^\circ$, F2: $52^\circ \rightarrow 315^\circ$]. Geomorphologically the affected area was moderately dissected with moderate vegetation. Some parts of the affected area are also having agricultural land along with some settlements.



Fig. 1: The Machong Landslide, East District, Sikkim.

Since the landslide is still active and intermittent movement of rock material is also observed, the entire zone of accumulation area needs further investigation. During the current site visit, it was observed, that there is an accumulation of debris, formed due to this landslide. Field observation shows that huge material has already been mobilised due to this slide and rock along with debris have already moved out from its active zone of depletion (natural hill slope) and chances of similar type of major sliding activity in the vicinity area seems lesser. Although, the possibility of minor sliding activities in the rainy season cannot be ruled out.

Since during the present site visit, the landslide was active and movement of material was going on intermittently, thus, close observation of its zone of depletion area can be planned at later stage. The tentative geoscientific reasons of this landslide as observed could be i) wedge failure, ii) heavy rainfall, iii) local shearing/ fracturing rendering poor quality of rock mass, iv) pore water pressure developed in open fracture surface v) steeper slope morphometry. During last few days there had been significant rainfall in the area. Hence, pore water pressure developed due to long saturation of antecedent rainfall could have played a pivotal role in triggering this massive landslide.

This landslide swept five buildings along with vehicles leaving a trail of destruction but fortunately no casualties took place despite the large scale of natural calamity. The landslide has also endangered several nearby houses as well. The landslide is likely to reoccur as cracks have developed in the hill above the road. The landslide has washed away a portion of the Pakyong-Machong Road that snapped the connectivity between Pakyong and villages like Pachey, Linkey and Machong. The water supply line to Nopgaon and Pakyong town has been breached due to the landslide.

FIELD DATA COLLECTION SHEET

Date	Location No.	Toposheet No	Locality/Village Name/NH/SH
12-07-2017	01	78A/12	Pachey, Pakyong-Machong Road near Pakyong
Latitude	27°14'29.2" N and	Longitude	88°36'24.5" E
Geomorphological process	Gravitational		
Geomorphological form	Moderately dissected		
Rock type	Phyllite (Daling group)		
Weathering	Moderate to High		
Rock Characteristic	Highly fractured		
Structural data (Dip/ Dip Direction of Planar Fabrics)	Foliation: N50°E/58°→ SE, Joint Planes [F1: 78°→28°, F2: 52°→315°].		
Fault, lineament etc., its nature & continuity	-		
Overburden Type	Highly weathered rock and soil		
Overburden thickness	1-3 m		
Land use Type	Moderately vegetated/ Agriculture/Settlement		
Hydrological Condition	Damp		
Erosion	Rill Erosion		
Susceptibility assessment of slope	Unstable		
Qualitative Risk Assessment	Risk: High		

LANDSLIDE INFORMATION

Length	Width	Height	Run out Distance
about 200m	about 120-150 m	about 100m	about 200m
Type of Material	Rock/debris		
Type of movement	Fall / Slide		
Failure Plane	Deep-seated (> 5 m)		
Activity	Active		
Distribution	Enlarging		
Style	Multiple		
Failure mechanism	Deep translational failure		
History	Initiation	Reactivation1	Reactivation2
	09.07.2017	10.07.2017	
Morphometry	Upslope: Natural Hill slope Down slope:-		
Triggering factor	Rainfall		
Casualties	Life	Livestock	Property
	6 persons injured	-	5 houses damaged
Geo-scientific Causes	Structure (Wedge failure), Rainfall, Lithology		
Remedial measures, if any	Still active		
Remarks	<p>Since the landslide is still active and intermittent movement of rock material is also observed, the entire zone of accumulation area needs further investigation. It has been observed, that there is an accumulation of debris, due to this landslide. Field observation shows that huge material has already been mobilised due to this slide and rock along with debris have already moved out from its active zone of depletion (natural hill slope) and chances of similar type of major sliding activity in the vicinity area seems lesser. Although, the possibility of minor sliding activities in the rainy season cannot be ruled out.</p>		
Photograph of Slide	See Fig. 1 in the note		