

# **MONITORING OF THE SONAPUR LANDSLIDE, JAINTIA HILLS DISTRICT, MEGHALAYA - A CASE HISTORY**

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## **ABSTRACT**

The most part of the north east in India is susceptible to the problem of landslides. The Sonapur is one of the important landslides located in the north east, in the state of Meghalaya. The landslide zone lies along the course of a perennial stream descending on the left bank of Lubha River at 141.8 km from Shillong in Jaintia Hills district, Meghalaya on National Highway no.44. It is an old, active, rock cum debris slide. It gets activated during the rainy season and severely affects the road communication. The sandstone, siltstone, shale sequence belonging to Barail group of Oligocene age are exposed in the slide zone. The monitoring of the slide was carried out between May, 2008 and September, 2008. Reference pillars were erected in the slide zone and regular monitoring was done to notice any displacement. Four reference pillars were completely washed out along with the debris during period of maximum rainfall, however no major landslide activity was reported during the period. It is observed that the poor rock quality, unfavourable orientation of joints and triggering effect of water during rainy season leads to sliding activity in the area. By adopting some of the remedial measures sliding activity can be minimised in the effected area.

## **Introduction**

Landslides are one of the important natural hazards. Landslide denotes the downward sliding, flowing or falling of a mass of rock, debris or earth under the influence of gravity. It poses serious threat to socio-economic and environmental condition. In India the Himalayas and the hilly regions are prone to landslide hazards. The state of Meghalaya is susceptible to the occurrence of landslides because of its rugged nature of terrain and fragile geology combined with the high annual rain fall. The assessment of landslide is usually undertaken by means of regular monitoring. The purpose of the study was evaluation of the various factors including geology, geomorphology, ground water and rain water that might have served as possible cause for the occurrence of landslide and to monitor its movement.

## **Study area**

The Sonapur landslide is located, near Sonapur village in Jaintia Hills district Meghalaya, on NH - 44 about 141.74 km, from Shillong. Because of its strategic position, the landslide has been studied from time to time by various workers including Raju and Chore, 1999, Avasthy and Ghosh, 2001 and Rao Subba K., 2007. The slide area can also be approached from Silchar enroute to Shillong. The slide zone lies at latitude  $25^{\circ} 06' 30''$  N and longitude  $92^{\circ} 21' 51''$  E. The area is devoid of human settlement except for a few hutments erected by the Border Roads Organisation (BRO) in the vicinity, away from slide zone for the maintenance of the National Highway. The landslide zone lies along the course of a perennial stream descending on the left bank of Lubha River. The landslide is spread all along the tributary having 870m length, and its width varies from 40m to 200m and slope angles ranges between  $11^{\circ}$  and  $71^{\circ}$ . It is an old, active, rock cum debris slide (Photo-1, 2, 3). It gets activated during monsoon period and blocks the highway thereby disrupting road communication to Agartala, Aizawl, Silchar and southeastern parts of the Meghalaya.

## **Geology of the area**

The area is represented by Mesozoic-Tertiary rocks overlying the Archaean Gneisses (Barman, G., 1967-68). The slide zone exposes sandstone, siltstone, shale sequence belonging to Barail Group of Oligocene age (Rao Subba K, 2007). Different litho units of the area can be studied along the southern flank where all the units are well exposed from lower level to the crown portion of the slide. The slide zone mainly consists of medium grained sandstone with interbedded siltstone and shale. Sandstone is medium grained, gray and hard. Thick units of sandstone show cross bedding structure. It is yellowish to reddish due to weathering effect. Thickness of sandstone beds varies from a few cms to a few meters. Shale is grey, splintery and friable and easily breaks into small pieces on exposure. Thin siltstone & clay occur alternating with sandstone and shale. Siltstone is gray to reddish in colour, hard and compact. Siltstone show slight pinching and swelling structure at places and is devoid of any internal layering/bedding. Both siltstone and clay form persistent to impersistent bands. The strike of the beds varies between  $N 80^{\circ} E - S 80^{\circ} W$  &  $N 75^{\circ} W - S 75^{\circ} E$  dipping moderately towards south. All the litho units are traversed by various joint planes and due to their varied orientation rock units form small blocks. Joint spacing varies from a few cms to more than a foot.

## Monitoring of the slide zone

The monitoring of the slide zone was taken up between May, 2008 and September, 2008. The zone of accumulation and toe part of the slide was mapped on 1:1,000 scale. Permanent reference pillar X was installed on the insitu sandstone (Fig.-1). The main reference pillars and permanent reference pillar were erected in the slide zone and monitoring was carried out using digital theodolite at regular intervals. These pillars were installed by constructing concrete and brick pillars. Assuming X as the permanent reference Station, seven reference pillars were installed in four alignments. The X-A1-A2 alignment direction is  $297^{\circ} \pm 30'$  where A1 reference pillar was installed on a detached sandstone block (4m X 5m X 2m) in the debris and A2 reference pillar was installed on a detached sandstone block (3m X 2m X 2m) towards the southern flank of the slide. The X-B1-B2 alignment direction is  $166^{\circ} \pm 30'$ , the B1 reference pillar was erected on sandstone boulder (2m X 1.5m X 1m) forming part of the debris. The B2 reference pillar was placed at left flank of the slide on debris material consisting chiefly shale, clay and sand stone fragments. The X-C1-C2 alignment direction is  $137^{\circ}$ . The C1 reference pillar was placed on debris. The C2 reference pillar was erected on the insitu rock- sand stone on the left flank of the slide. The X-D1 alignment is  $61^{\circ}$  where D1 reference pillar is placed on insitu sandstone unit. In addition ( X  $\pm 30'$  ) RL 150.44m observation point were marked on insitu sand stone 1m above the reference station X. The A  $\pm 2'$ , B  $\pm 2'$ , C  $\pm 2'$  and D  $\pm 1'$  observation points also were marked on insitu rocks by the side of A2, B2, C2 and D2 reference pillars for reference purpose in case of washing out of reference pillars during heavy rains. Monitoring work was taken up periodically with help of digital theodolite to notice any movement in the slide zone. Till August, no displacement in the position of reference pillars was observed. However, in September, it was observed that four reference pillars (nos. A1, A2, B1 & C2) had been washed out along with debris movement in the slide zone. These four erected reference pillars were dislodged from their respective places and no trace of these pillars were found. Erected permanent reference pillar no.- X was also washed out but the in-situ rock on which the X was placed was intact. Reading of other three observation pillars no.- B2, C1 & D1 were taken and no significant movement was found.

## CONCLUSION

The Sonapur landslide is an old, huge rock cum debris slide, activated every year during raining season which severely affects road communication. The monitoring of landslide was carried out between May, 2008 and September, 2008. Permanent reference pillar X and a total of seven reference pillars were installed in the slide zone for monitoring. It was observed that four reference pillars were completely washed out along with the debris movement with maximum rainfall. However, no major landslide activity was recorded during the period. The poor rock mass quality, unfavourable orientation of joint planes, descending stream through slide zone combined with the triggering effect of water during rainy season leads to sliding activity in the area. Shale and clay being soft and incompetent in nature are easily carried away from its place leading to destabilization of overlying sandstone units which eventually are removed and brought down the slope. The stream originating from the hill top is dissecting all the lithological units, thereby facilitating the removal of support (Shale beds) from the overlying sandstone beds, making these units unstable and susceptible to sliding. This process has been in operation since long and is responsible for removal of huge quantity of material down the slope. The river channel of Lubha has been considerably narrowed by the accumulation of slide debris (Photo-4). This process has been more active in the northern flank of the slide zone as compared to the southern flank which is steep and is more susceptible to rock fall and wedge failure on account of its structural disposition.

Slide morphometry of Sonapur landslide has been changed a lot over the years and the debris material which was noticed along the slide zone at different levels have been nearly washed out. During the period of monitoring, only minor sliding activity was noticed in the slide zone with no major sliding activity as compared to the occurrences of some major sliding activity in the previous years when the road communication was severely affected. It probably indicates that slide is still active although its pace appears to have slightly been slowed down as compared to previous years which further needs to be monitored.

Removal of large loose blocks from stream course, construction of retention walls across the slope of the slide, proper drainage of surface runoff, benching of the slope, removal of destabilized material from the northern flank and construction of retaining wall on the southern flank of the slope would be helpful in minimizing the sliding activity in the effected area.

## **REFERENCES**

- Awasthy.R. K, Dr. Ghosh.R.N. (2001) A note on the Landslide near Sonapur, Jaintia Hills District Meghalaya.
- Barman, G. (1967-68): Systematic geological mapping of sedimentary rocks and investigation of phosphates along the southern and southeastern flanks of Jaintia Hills, Assam, Unpublished GSI report.
- Raju M., Chore, S.A. (1999): A report of preliminary landslide appraisal studies in parts of Assam and Meghalaya.Unpublished GSI report.
- Rao Subba K. (2007): Interim report on site specific studies of Sonapur landslide, Jaintia Hills district, Meghalaya.Unpublished GSI report.



**Photo-1:** View of Sonapur landslide, Jaintia Hills district, Meghalaya



**Photo-2:** Rock sliding along with top soil cover



**Photo-3:** Debris accumulated by sliding



**Photo-4:** Narrowing of Lubha river channel by accumulation of slide debris

**Fig.1 Geological map of Sonapur landslide**

