

**GOVERNMENT OF INDIA
GEOLOGICAL SURVEY OF INDIA**



**REPORT ON THE PRELIMINARY POST DISASTER INVESTIGATION OF
LANDSLIDE OCCURRED ON VITTAL-MANILA ROAD, BANTWAL
TALUK, DAKSHINA KANNADA DISTRICT, KARNATAKA**

(Additional Item)

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Introduction: The monsoon showers of July 2010 caused many landslides in Western Ghats. As per the instruction received from the Dy. Director General, SU: Karnataka and Goa and the letter from the LHIM & EPE Division, GSI, New Delhi the preliminary investigation of the post disaster study of the landslide occurred near Kadengodlu led to the closing of the Peruvai-Kadengodlu road connecting Vittal to Manila in Bantwal Taluk, Dakshina kannada district was taken up to assess the nature and causes of the landslides including the future risk and vulnerability at the site. The landslide has occurred on 20.07.2010 and the road was blocked which was cleared within two days. The preliminary post disaster landslide investigation was carried out on 30.07.2010.

Location of landslides: The Landslide was occurred near Onibagilu village on Peruvai- Kadengodlu road connecting Vittal to Manila in Bantwal Taluk, Dakshina Kannada district. As per GPS the area was located at Longitude $12^{\circ}41'40.9''$ N and latitude $75^{\circ}03'55.2''$ E and situated at 235 M.asl (Fig 1). The area is 2 km south of Peruvai and fall in toposheet no 48P/2.



Fig 1: The Google image showing the location of landslide.

Physiography of the Area: The landslide was located on vertically cut slope of the road across E-W trending laterite mound. The maximum height of the mound is 100 m above MSL with slope angle $\sim 20^\circ$. The main river is Shiriya which is flowing towards E-W direction at about 3 km south from the slide. The area receives a high rainfall during monsoon. The laterite capping which is recent in origin is formed due to highly weathering and leaching action of rainwater followed by dryness. A large water pond was noticed at 150m away from the slide. No natural streams noticed adjacent to the slide.

Land use and Land cover: The slope has been modified for making local road and the area is thinly populated. This area is well known for areca nut plantation. The modification includes (the data gathered from local residents and inferred from site condition) construction of roads, plantation in the form of cashew trees and areca nut. The slope is moderately vegetated with shrubs and cashew plants both having low root and shoot ratio. A small trench was made above the slided road to demarcate the land and property in which the water was continuously flowing through it during rainy days. This might be the cause for the land slide

Geology at the site: The Regional Geology of the area is represented by rock types of Charnockite and Peninsular Gneiss Complex (PGC) of Archean Age. The local geology pertaining to slide area is the laterite exposed over saprolite (weathered gneiss).

The landslide: The landslide occurred on 20.07.2010 near Onibagilu village and the road was blocked which was cleared within two days. Peruvai-Kadengodlu road connecting Vittal to Manila in Bantwal Taluk, Dakshina Kannada district was mainly affected. There was no loss of property nor any casualty reported.

Slide morphometry:

- a) Length of the slide: $\sim 15\text{m}$
- b) Width of slide: $\sim 34\text{m}$
- c) Depth of slide: $\sim 2\text{m}$
- d) Base Length: 60m
- e) Scarp radius: $\sim 25\text{m}$
- f) Scarp height $\sim 3\text{m}$
- g) Scarp angle: -vertical to concave
- h) Two sets of Joints observed in Gneisses as follows
 1. $N50^\circ E$ / dipping $42^\circ NW$, 1.0m to 1.5m spacing, 3-5 cm opening and filled with clay/soil
 2. EW / dipping $70^\circ N$, 20 cm to 1.0m spacing, 2-4 cm opening and filled with clay/soil
- i) Cut slope height near the toe: 15m
- j) Slide direction: $N70^\circ W$
- k) Slope prior to failure: 85°

- l) Slope after failure: 75°
- m) Shape of the slide: Irregular
- n) Horizontal extent of the slide: 4.0m
- o) Vertical interval of the slide: 19.0m
- p) Overburden thickness: soil of 0.5m
- q) Crown condition: Unstable
- r) Head condition: Unstable
- s) Toe condition: Unstable
- t) The slide is a wedge failure. The two joint sets are making the wedge failure.

Rainfall data: As the area receives very high rainfall during the monsoons, data was collected from the nearest available rain gauge station in Bantwal and antecedent and precedent distribution pattern was worked out. (Table 1& 2; Figure 2). Though the rainfall data is not from the actual site the general trend of rainfall may be brought out from the data.

Table: 1. Rain fall data for the month of June 2010 at Bantwal Rain gauge Station

Date	Rain fall (in mm)	Date	Rain fall (in mm)
01.06.2010	0.6	17.06.2010	41.8
02.06.2010	-	18.06.2010	63.4
03.06.2010	-	19.06.2010	7.0
04.06.2010	-	20.06.2010	21.2
05.06.2010	-	21.06.2010	-
06.06.2010	4.2	22.06.2010	0.6
07.06.2010	25.4	23.06.2010	39.4
08.06.2010	18.4	24.06.2010	63.12
10.06.2010	6.2	25.06.2010	51.10
10.06.2010	-	26.06.2010	14.8
11.06.2010	-	27.06.2010	253.4
12.06.2010	23.8	28.06.2010	-
13.06.2010	31.6	29.06.2010	-
14.06.2010	37.6	30.06.2010	-
15.06.2010	145.8		
16.06.2010	75.4	Total	924.8

Source: Taluk office, Bantwal Taluk, Dakshina Kannada dist., Karnataka

Table: 2. Rain fall data for the month of July 2010 at Bantwal Rain gauge Station

Date	Rain fall (in mm)	Date	Rain fall (in mm)
01.07.2010	8.8	17.07.2010	57.4
02.07.2010	40.6	18.07.2010	21.0
03.07.2010	38.0	19.07.2010	52.2
04.07.2010	71.0	20.07.2010	68.4
05.07.2010	52.6	21.07.2010	56.2
06.07.2010	40.6	22.07.2010	47.8
07.07.2010	26.4	23.07.2010	7.6
08.07.2010	19.4	24.07.2010	17.6
10.07.2010	1.4	25.07.2010	24.6
10.07.2010	-	26.07.2010	22.4
11.07.2010	-	27.07.2010	26.6
12.07.2010	-	28.07.2010	29.2
13.07.2010	-	29.07.2010	54.6
14.07.2010	-	30.07.2010	173.4
15.07.2010	7.6	31.07.2010	69.0
16.07.2010	70.0	Total	1104.4

Source: Taluk office, Bantwal Taluk, Dakshina Kannada dist., Karnataka

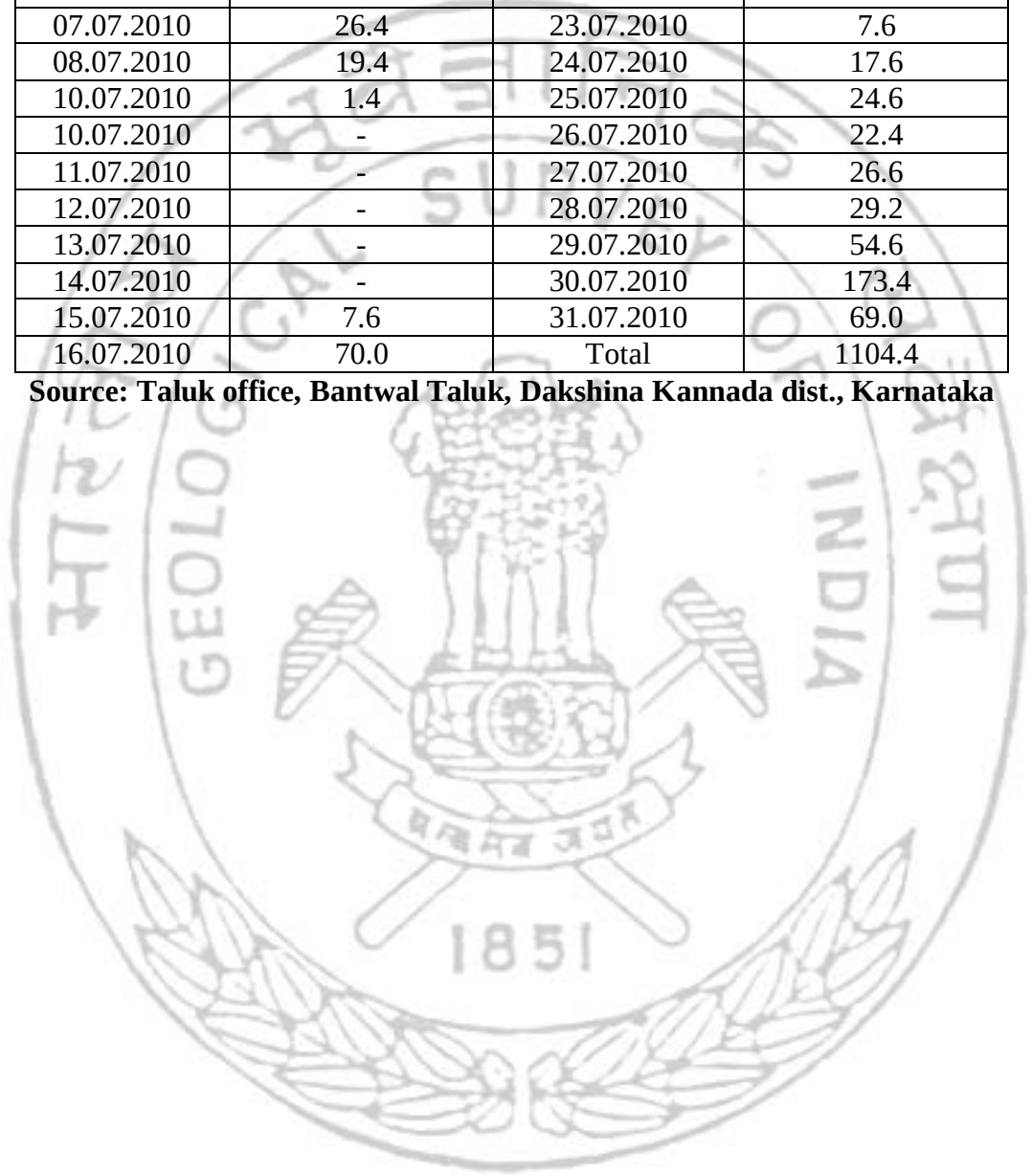
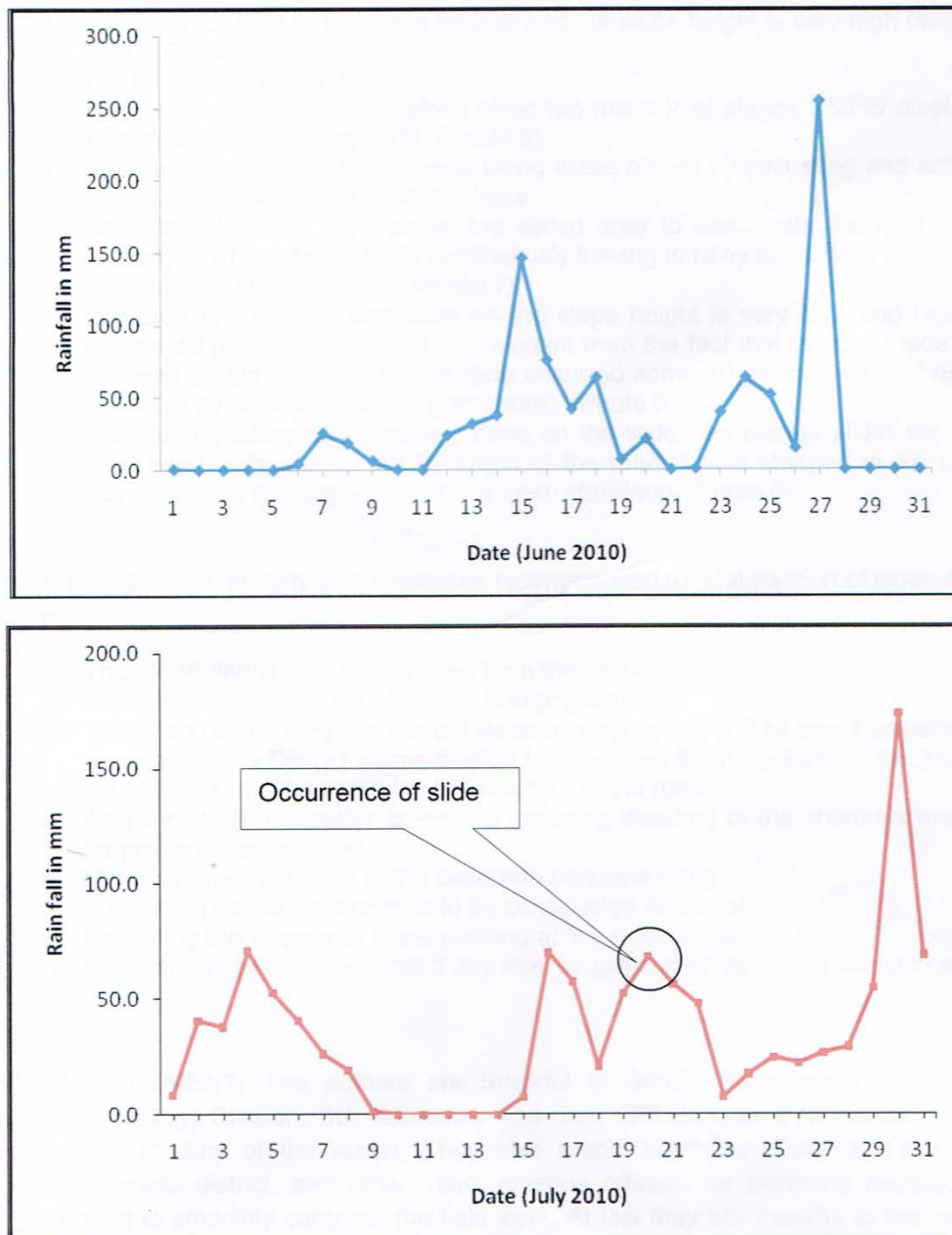


Fig: Antecedent and precedent rainfall distribution pattern and the sliding event**Fig 2: Antecedent and precedent rainfall distribution pattern and the sliding event**

Slide material: The slide material in the zone of accumulation and depletion is debris comprising of different fraction of gneisses/weathered gneissic material. The gneisses are highly weathered and patches of limonitic clay are seen on the debris material. The size fraction of debris varies from huge gneissic boulders to small cobbles and pebbles and soil/clay material.

Causes: The causes of this slide are as follows

- a. Slope cut for road formation is vertical and cut slope height is very high (about 15m). (Photo 3)
- b. The failure is a wedge failure.
- c. The wedge failure occurred along other two major joint planes N50°E/ dipping 42°NW and EW/ dipping 70°N. (Photo 5)
- d. High rainfall removed the material along these planes by infiltrating and acted as lubricant reducing the resisting force.
- e. Small trenches are seen above the slided area to demarcate the land and property in which the water is continuously flowing in rainy days. This acted as catalyst agent for infiltration. (Photo 7)
- f. The area is prone for landslides as the slope height is very high and highly weathered gneissic body. It is also evident from the fact that the other side of the road an old slide exists (the slide occurred some 10 years back and now stabilised by providing retaining structure). (Photo 8)
- g. The slope grading and benching done on the slide (the current slide) should have been complete for whole length of the road. It was stooped in the mid way otherwise the slope would have been stabilised. (Photo 6)

Recommendations: The corrective measures recommended for stabilisation of slope are as follows

- a. The slided debris is to be removed from the slope.
- b. Remove all the loose boulders and hanging boulders.
- c. Reduction in the height of the cut slope by slope grading. The benches/berms, provided by the District administration has reduced the magnitude of the slide, the benches may be extended to full length of the road.
- d. Arrest infiltration of water at the top including diverting of the channels made for property demarcation.
- e. Make a proper drainage at the base with concrete lining.
- f. A retaining wall of 2m height is to be constructed at the toe.
- g. Backfilling the slope with stone pitching at 1:1 slope angle.
- h. Long term remedial measures if any may be given after detailed investigation.

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LIST OF PHOTOGRAPHS

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Photo 1: View of the landslide near Onibagilu on Peruvai- Pakalkunja road connecting Vittla and Manila on 21.07.2010(a day after the slide). [courtesy daijiworld.com](http://daijiworld.com)



Photo 2: View of the landslide near Onibagilu on Peruvai- Pakalkunja road connecting Vittla and Manila on 21.07.2010(a day after the slide). [courtesy daijiworld.com](http://daijiworld.com)



Photo 3: landslide near Onibagilu on Peruvai- Pakalkunja road connecting Vittla and Manila. The right side of the road is new slide and left side is the old stabilised slide.



Photo 4: landslide near Onibagilu on Peruvai- Pakalkunja road connecting Vittla and Manila with fallen debris on toe part of the slide.



Photo 5: Head portion of the slide showing weathered Gneissic exposure with two sets of prominent joints.



Photo 6: Improper benching at the mid slope, proper extension of bench to whole slope might have prevented the slide.



Photo 7: channels made for property demarcation on the crown portion of the slide from which water is directly draining in to the slide area.



Photo 8: view of the landslide on the other side of the road which has been stabilised by providing retaining structure and slope grading.

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