Site Investigations in Sri Lanka

Objective: Site investigations and feasibility studies for installing landslide monitoring instruments at various JICA funded sites in Sri Lanka

Location: Nuwara Eliya, Sri Lanka

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Duration: March 20th to March 23rd, 2014

Site-1: UVA Wellasa University Site

GPS: 6º 58' 56.72" N, 81º 4' 35.71" E

Some key features of this landslide site are as follows;

- The slope comprises of highly weathered rock
- Very high annual rainfall (~ 3500 mm)
- Besides the area is sometimes subjected to extremely heavy showers. Amount of rainfall of a single such shower may sometimes accumulates to around 165~170 mm.
- During heavy rain showers in December 2010 through January 2011, cracks started appearing in several houses situated in the landslide area.
- Until now 16 houses have totally subsided whereas another 20 houses have developed severe cracks.
- Overall length of the landslide is quite large as approximately 1 km strip of land appear to be moving.
- Cracks are clearly visible at various locations on the slope surface. Movement of the soil is well beyond 1 m at various such crack locations.
- Ground water table appears to be quite shallow (Fig. 4). Thus even small rainfall can potentially trigger rapid movement.
- Restricting the movement of such a massive slope may not be possible. However, monitoring instruments can help in identifying the risk involved and issue early warning to minimize damages.

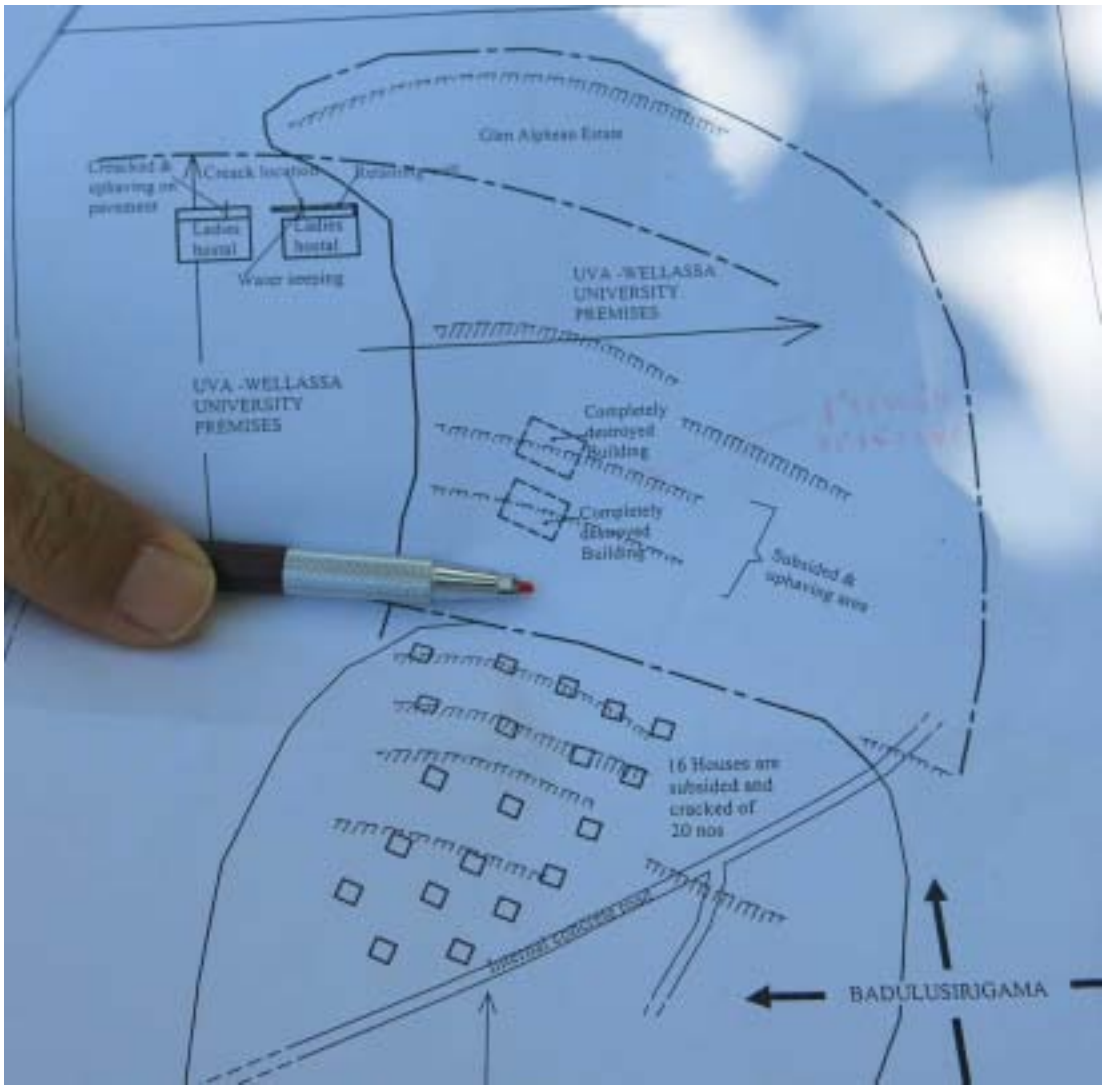

Figure 1: Sketched plan of the affected site.

Figure 2: Visible cracks on slope surface.

Figure 3: Large cracks and humps formed due to slope movement.

Figure 4: Water gushing through the soil.

Figure 5: Some debris and plastic waste found in the soil near toe of slope.

Figure 6: Deterioration of the road near the toe of slope.

Figure 7: Damaged houses near the toe of slope.

Figure 8: Damaged houses near the toe of slope.

Site-2: Glen Apline Estate Site

GPS: 6º 58’ 38.7” N, 81º 4’ 55.6” E

Some key features of this landslide site are as follows;

- Failure triggered during December 2010 and January 2011 storms.
- Very high annual rainfall (~ 3500 mm) in this area.
- Very heavy showers (165~170 mm) were observed during the said rainy season.
- Bungalow near the top of slope (location: GPS-4 in Fig. 9) was severely damaged due to slope movements.
- Some parts of the road which is running through the slope surface (location: GPS-2 in Fig. 9) have collapsed due to gradual slope movement.

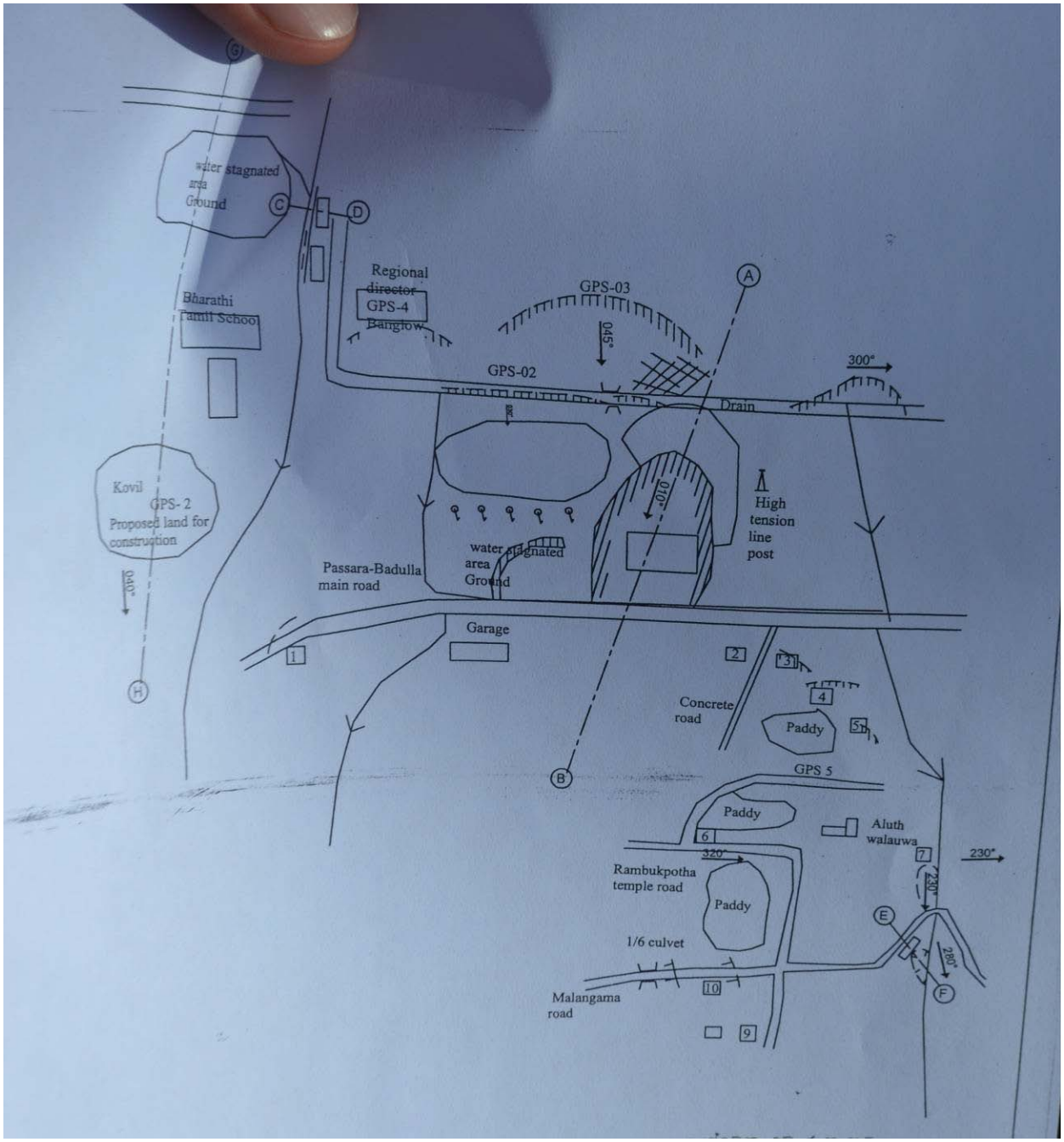

Figure 9: Sketched plan of affected area.

Figure 10: Poles tilted due to ground movement (location: near top of slope, GPS-4 position in Fig. 9)

Figure 11: Cracks in Bungalow building (location: near top of slope, GPS-4 position in Fig. 9)

Figure 12: Cracks in Bungalow building (location: near top of slope, GPS-4 position in Fig. 9)

Figure 13: Damage to road along location GPS-2.

Figure 14: Damage to road along location GPS-2.

Site-3: Kahagolla Site (National Highway A6; 10 km BM)

GPS: 6º 47’ 33.4” N, 80º 58’ 24.9” E

Some key features of this landslide site are as follows;

- Very slow movement of slope section along National Highway Route A6.
- Route A6 is a very important route for tea transportation.
- Very clear signs of slope movements are still not found but the slope is suspected to be moving by Sri Lankan officials. They tried to conduct magnetic survey to monitor slope movements but unfortunately there was no rain during that time, hence they could not confirm the movement.
- Tilt sensors and moisture sensors can provide a better picture.
- A small water catchment has been found at the rear end of the slope. It is expected to be acting as a water charge for moving slope.

Figure 15: Overview of Kahagolla landslide site.

Site-4: Dodangoda Landslide (Along Southern Expressway – E01)

Some key features of this landslide site are as follows;

- Southern expressway was opened for traffic in 2011.
- During November 2012, after one week of continuous rainfall (~ 345 mm), a large slope failure occurred along its bank.
- Failed slope was part of a cut slope, which was cut to accommodate the highway at its center (Fig. 15).
- Recently they have installed three piezometers to monitor the fluctuation of water table. The piezometers have been installed 7 m above road level and they have found that the water level is generally 1-2 meter above road level.
- Previously installed water drains were probably choked during heavy rainstorms hence pore water could not dissipate and led to failure of slope.
- Currently planned restoration method includes soil nailing in the already failed part of the slope in order to strengthen it. Whereas an improved water drainage facility in the form of weep holes is being provided on either sides of the failed slope. This is expected to improve drainage, dissipate pore water pressure and hence reduce the risk of slope failure.

Figure 15: Cut slope to accommodate the highway

Figure 16: Overview of Dodangoda landslide site.

Figure 17: Conversion of ordinary PVC pipes into landslide drainage pipe.

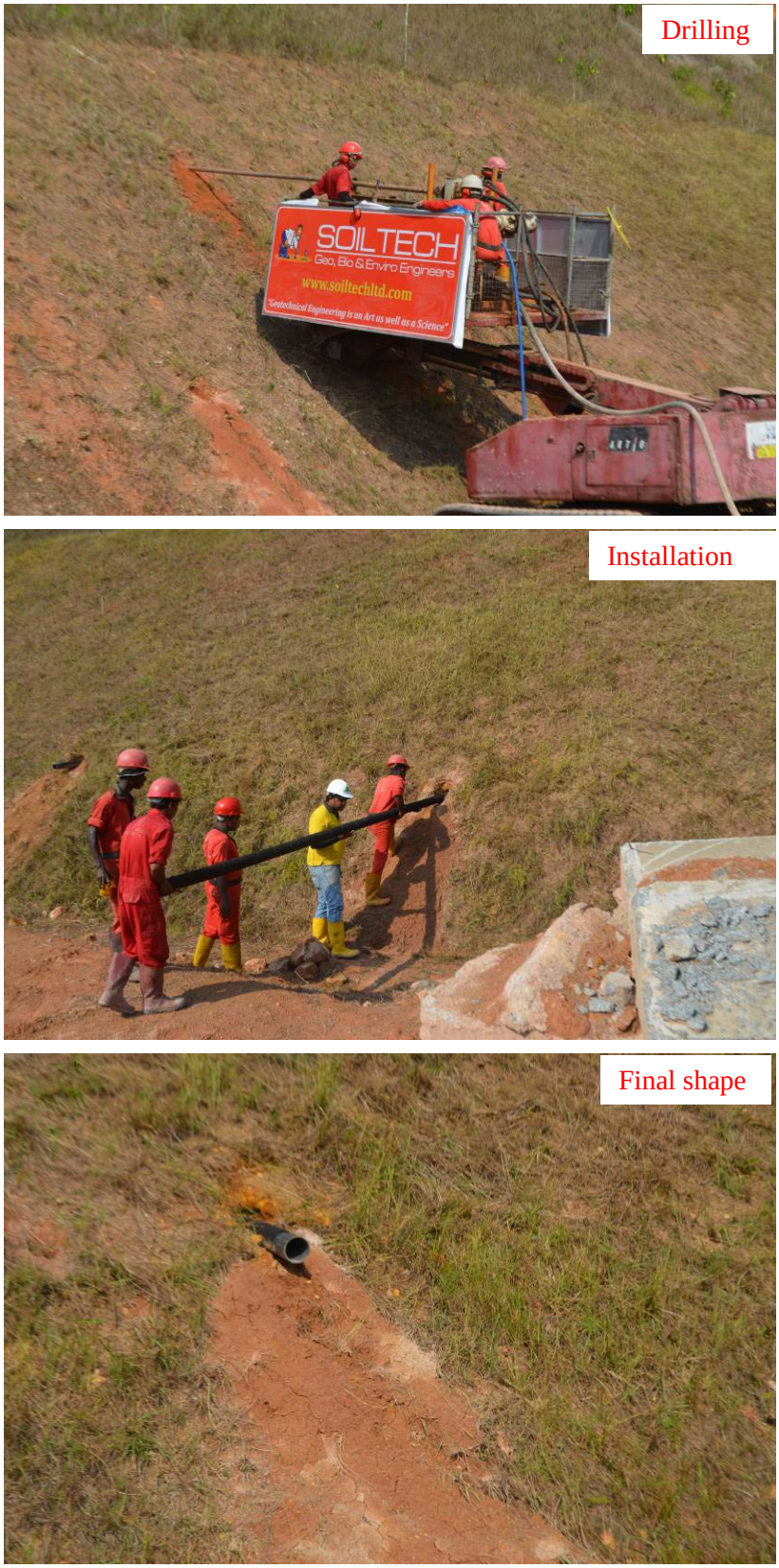

Figure 18: Installation of drainage pipes on the slope.