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TECHNICAL NOTE

ENGINEERING GEOLOGICAL OF AN ACTIVE SLOPE IN KM46 SIMPANG PULAI, PERAK

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Abstract: Engineering geological mapping is an essential tool to understand the geotechnical threshold values triggering slope failures. The slope chosen is the KM 46 Jalan Simpang Pulai-Cameron Highlands in Perak. A geological map composed of the confirmed and probable bedrock layer may it be on the ground surface or immediately underneath the soil layer. The soil layer can be transported materials and also can be the residual soil of the bedrock. Engineering geological maps include additional engineering geological information such as dips and strikes of the unconformities, Standard penetration Tests (SPT) values .geormorphological informations and topograhy inputs.

Keywords: *Slope, engineering geological map*

1.0 Introduction

The term “Landslides” can be defined as a process that results in the movement of downward or outward of slope forming material such as rock and soil. The earliest landslide tragedy recorded in Malaysia was in 1919 at Bukit Tunggal, Perak. There are numerous landslide tragedies in Malaysia recorded since then and involves huge numbers of fatalities and economic losses. Malaysia, comprising Peninsular Malaysia and East Malaysia is located at about 3^{o}N of the equator and experience a hot and humid climate all year round with temperatures ranging from 22 to 32^{o}C. The annual rainfall averages from 200cm to 250cm with extremities during the annual southwest (April to October) and northeast monsoons (October to February). Slope failure and landslides are becoming more frequent of late. Public discussions ensued and comments from local experts to members of parliament ranges from the failure of exposed geological weaknesses to the weathering parameters, soil erosion, designed slopes were not done as it should be, exceptionally high rain fall during the particular period and uncontrolled denudation of the surrounding areas.

The study area is located at KM46, Jalan Simpang Pulai – Cameron Highland, Perak GPS coordinate of 4° 35' 53.51"N, 101° 20' 49.84"E. The size of the slope studied was 35 meters length and 10.5 metres width. The location situated at elevation ranging from 500m to 2000m. The geology of the highway comprises of granite and combinations of several metasedimentary rocks, namely schists and phyllites. About 63% of the whole stretch is underlain by granite while the rest is metasedimentary rock (Omar, 2002). Schist rock is dominant for the KM 46 Simpang Pulai-Cameron Highland road. The bedding planes and foliation of the schist are almost parallel each other. This schist is well foliated. The schist is postulated to be of Upper Palaeozoic age (Gobbett, 1972).

Engineering geological map is an overview of engineering and geological conditions of a certain area. It has both geological and engineering information. The map is a compilation of varies information. In order to produce the maps, geological complexity need to be closely considered (Ivanović, 1979). Basic information related to engineering geological maps such as choice of geological mapping scale, working with geological mapping methods and how the map will be presented. Borehole details were obtained to investigate the underneath failure thus can enhance information in the engineering geological map (Matula, 1973). This paper describes the engineering geological maps produced and how they were developed.

2.0 Materials and Methods

The engineering geological map is based on a base map, the geological map from topography map from Jabatan Ukur Malaysia (JUPEM) Fig, 1(a) and Jabatan Mineral Geosains (JMG) Fig. 1(b). The data were taken based on the study area locality. Smaller scale 1:10000 was used to produce this map as it involves small study area. The data that includes details on geological and morphological were used to relate and describe with borehole details.

On the field, a walk-through survey was conducted to obtain the overview of the site geology and conditions of the slope. All data related with the slope were taken such as the dips, strikes and slope characteristics. Several boreholes were sunk and samples were taken using split spoon sampler. The locations of the boreholes were identified by considering the most probable movement to occur based on the site observations Samples were tested in laboratory in order to obtain the physical properties.

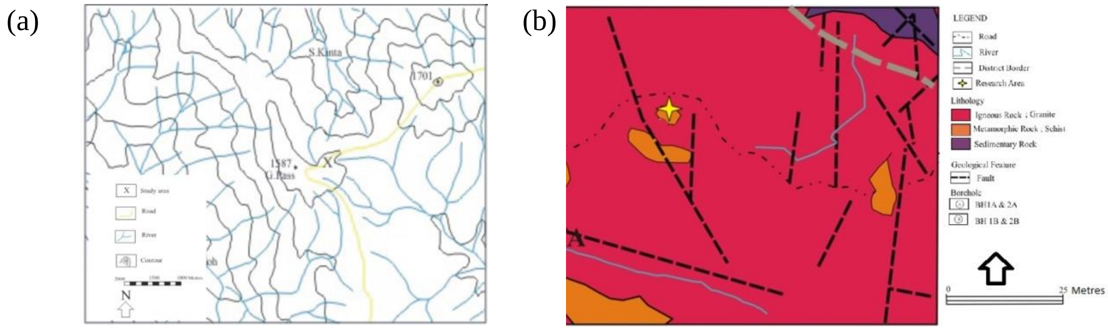

Figure 1: (a) Topography map of Simpang Pulai- Cameron Highlands area from JUPEM (b) Geological map of Simpang Pulai- Cameron Highlands area from JMG

3.0 Results and Discussion

The topography of the research area can be classified as terrain or hilly based on the elevation the surround area ranging between 1300m until 1700m. The research area situated nearby a hill named Gunung Pass with its highest peak at 1507m. The research area had a slope considered as unstable. Concrete foundations were ripped away from the slope. There were a few of old scarps and new scarps detected (Fig. 2.).The largest scarp was 10.5 m width and located at height of 12m from road. The existence of high number of scarps, can lead to the high possibility of sliding to be activated and another slope failure should occur in the near future.

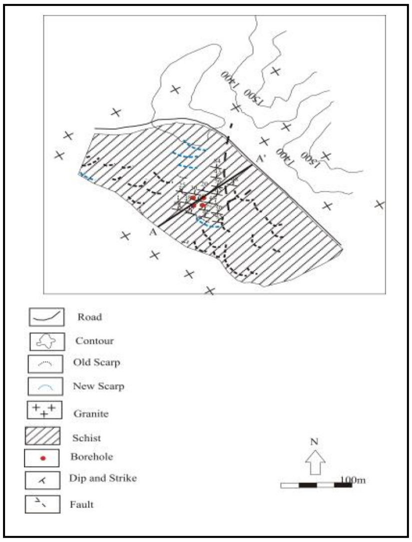

Figure 2: Engineering geological map of slope KM 46 Simpang Pulai-Cameron road

Geological structure can occur from tectonic activities. The most prominent geological structures that can be identified from engineering geological cross section in Fig.3 is the fault structure. There is one major fault nearby the research area. The fault orientation is oriented to the Northwest direction same orientation with dip direction of slope dip. This situation will cause failure for the slope. Streographic analysis for the fault also shows there is wedge failure detected because the intersection lines of major planes falls at unstable area Fig. 4. There were also few old scarps and new scarps detected

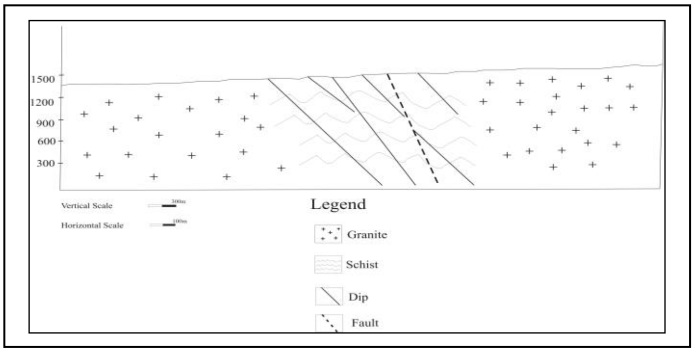

Figure 3: Engineering geological cross section

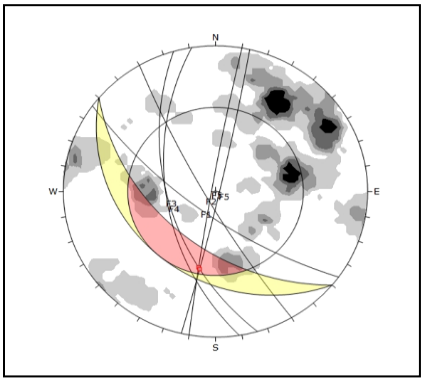

Figure 4: Fault streographic analysis

Subsoil investigation works were conducted to understand the factors that might contribute to the slope movement. The soil investigation involved four boreholes with Standard Penetration Test (SPT) and wash borehole drilled to the hard layer. Fig.5 shows the position of four boreholes at different levels with respect to the road level. Borehole 2A and 2B were drilled 70m from the road meanwhile borehole 1A and 1B were drilled 124m from road and 54m from borehole 2A and 2B.

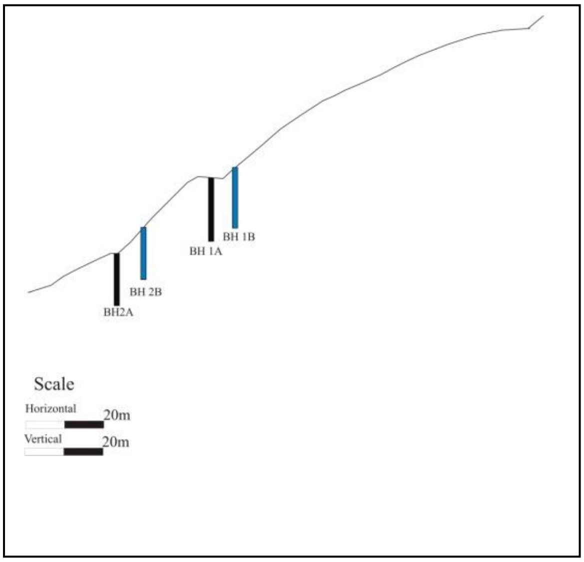

Figure 5: Four boreholes position

A hard layer is defines SPT N=50 blows. In borehole 1A, the hard layer was encountered at 15m below ground level, 15.5m for borehole 1B, 15m for borehole 2A and 13.5m for borehole 2B. The holes were terminated after 3 times N=50 blows which represents 4.5m thick hard layers. From the laboratories test, the materials forming the residual soils are sandy SILT to silty SAND. Three units type of soil were recognized as distinct geotechnical units which were sandy silt, very silty very gravelly sand and fragments of schist. The sandy silt unit consists of light grayish, dark yellowish, light yellowish to dark brownish colour with mixtures of sand and silt. The SPT value range from N= 5 to 50. The hardness varied from very soft to hard. The percentage of silt was more than 50% and sand is 20% to 35%. The very silty very gravelly sand unit varied from dark grayish to dark brownish colour. This unit composes mixture of sand, silt and gravel. The average composition for this unit was more than 50% is sand, 20% to 35% is silt and another percentage was gravel. The hardness of this unit was from very loose to very dense. Cross section from boreholes results (Fig.6) shows there were movement in BH2A and BH2B and this situation can be classified as shear zone. This showed that there was deep seated movement at great depths. However, the movement was very slow and will increase during rainy seasons. Another factor identified from the profile (Fig.6) was the existence of schist fragments that contribute to the infiltration of water, thus, allow rapid rate of weathering and produce unstable materials.

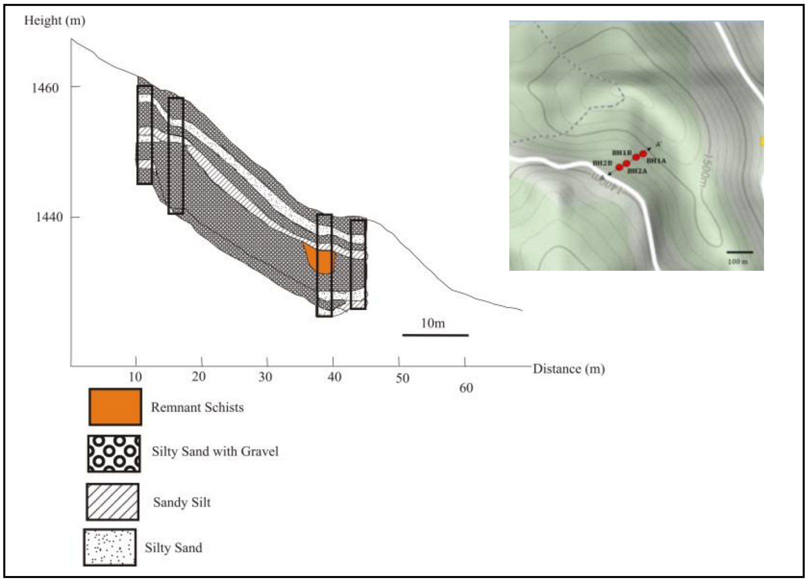

Figure 6: Borehole profile cross section

4.0 Conclusions

The engineering geological map of slope KM 46 Simpang Pulai- Cameron road gives an overview on the ground condition. A very distinct relation with the geological and geotechnical characteristic can be explained from the borehole profiles. This map can also explain the topography and geomorphology of research area. Factors influencing slope failures can also be recognised. Based on the results, fault can be one of the contributing factors of slope failure. Another factors detected was the existence lenses of schist fragments because of it can be classified as loose material having non-cohesive to non-cohesive properties and that allows water to easily penetrates in between layers. This can cause rapid weathering and produce unstable materials. Combination of the engineering geological maps and borehole details can give invaluable information about the ground condition to engineers for further considerations.

5.0 Acknowledgements

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