Engineering Geological Investigation on Slope Failure along Bundu Tuhan to Kundasang road, Sabah, Malaysia

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Abstract: This study focused on the engineering geological investigation on slope failure along Bundu Tuhan to Kundasang road, approximately 84th km to 96th km from Kota Kinabalu city, Sabah. The area is underlain by the Trusmadi Formation (Palaeocene to Eocene age), the Crocker Formation (Late Eocene to Early Miocene age) and the Pinousuk Gravel (Upper Pleistocene to Holocene age). These rock units are carved by numerous lineaments with complex structural styles developed during series of regional Tertiary tectonic activities. The tectonic complexities reduced the physical and mechanical properties of the rocks and produced intensive displacements in substrata, resulting in intensive high degree of weathering processes and instability. The weathered materials are unstable and may cause depression and sliding induced by high pore pressure subjected by both shallow and deep hydrodynamic processes. In this study, a total of 43 selected critical slope failures were studied. This study classified the slope failures into two main groups: soil slope failures and rock slope failures. Failures in soil slopes (including embankments) total 35 (81 %) whereas 8 failures (19 %) of rock slope. Soil slope failures normally involved large volume of failed material compared to rock slopes, where most failures are small to large size. Of the 35 failures in soil slopes, 31 (89 %) are embankment failures making them 72 % of all types of failures. Physical and mechanical properties analysis for one hundred twenty four (124) soil samples indicated that the failure materials are mainly consists of clayey loamy soils, which characterized as low to intermediate plasticity content (8 % to 27 %), very high to medium degree of swelling (3.76 to 12.68), low to high water content (3.35% to 36.31%), low permeability (9.66 X 10-3 to 4.33 X 10-3), friction angle (ϕ) ranges from 7.70° to 35.50° and cohesion (C) ranges from 0.36 kPa to 25.13 kPa. The rock properties characterization for eight (8) rock samples indicated that point load strength index ranges from 0.33 mPa to 0.52 mPa (moderately week) and uniaxial compressive strength ranges from 7.81 mPa to 12.57 mPa (moderately week). Evaluation of 60 boreholes data in the study area reveals that the depth of the groundwater table ranges from 1.90 m (6 feet) to 11.20 m (35 feet) deep. The groundwater level in the study area fluctuates even within a short period of any instability of climatic change. Engineering geologic evaluation of the study area indicates that the slope failures took place when rock and soil materials are no longer able to resist the force of gravity. These decrease the shear strength and increase the shear stress resulting failures, which is due to internal and external factors. Internal factors involve some factors change in either physical or chemical properties of the rock or soil such as topographic setting, climate, geologic setting and processes, groundwater condition and engineering characteristics. External factors involve increase of shear stress on slope, which usually involves a form of disturbance that is induced by man includes removal of vegetation cover, induced by vehicles loading and artificial changes or natural phenomenon such as tremors. Development planning has to consider the hazard and environmental management program should be implemented. This engineering geological study may play a vital role in slope stability assessment to ensure the public safety.

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