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An investigation of the variation of shear strength of soil with its moisture content

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The mechanical behavior of soil is highly dependent on its shear strength. Cohesion and internal friction angle and effective stress of soil are important factors of soil shear strength. The key objective of this study was to establish a relation between the shear strength of unsaturated soil and its moisture content. In the current study, different types of soil such as red gravel soil, mud from a paddy field, sand, soil from rubber cultivation, home garden soil and soil from an ant-hill type in Sri Lanka were used as the raw material. Before the shear strength measurement, the selected soil sample should be well dried and free from impurities. The apparatus set up was designed to measure the limiting friction force of the soil sample with the varying moisture content while maintaining a constant density in all the raw soil samples. In the present study, limiting friction force acts as the shear force of the particular soil sample. Shear stress was calculated by dividing the shear force by the contact surface area of the soil. According to soil mechanics, shear strength is the magnitude of shear stress that soil can sustain. The obtained results reveal that the moisture content has a great influence on the shear strength. The shear strength started to increase gradually relative to the increasing water content. At a specific point, the shear strength reached a peak level, beyond which it started to decrease gradually with the increase of water content. The characteristic curves of shear strength against the moisture content displayed some changing aspects according to the soil type. According to the results, the maximum shear strength was observed in the soil from the rubber cultivation and the minimum was observed in the sand sample. The maximum shear strength of the soil varied in the range $(2.421 \pm 0.006 - 8.500 \pm 0.266) \times 10^2 \text{ Nm}^{-2}$. The highest value of the optimum moisture content was observed in red gravel soil while lower values of the optimum moisture contents were observed in soil from an ant-hill, mud from a paddy field, and sand. The optimum moisture content of the soil varied in the range (7-30) g. High soil moisture content is the main cause of landslides. The results of the present study can be used to get an idea about the specific moisture content which could cause a landslide. In this study, a direct comparison of maximum shear strengths of six different soil types in Sri Lanka was made and the relevant results could be useful in making predictions about the landslides that occur due to heavy rain. However, geotechnical engineers have to consider factors like geological composition, surface drainage, groundwater content, in addition the shear strength of soils in assessing the stability of hill-type lands.

Keywords: Moisture content, Shear strength, Soil