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ANALYSING SOIL PATTERN AND CHARACTERISTIC OF UNDERGROUND PIPELINE USING GROUND PENETRATING RADAR (GPR) AT TWO DIFFERENT STUDY AREA

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ABSTRACT

The work of detecting buried underground utilities had become one of the most important part in every construction project in order to avoid damaging to any existing buried underground utilities. The condition of the buried underground utilities and soil subsurface conditions can be observed by correctly interpret the radargram image and the textural features contained in them. Due to the nature of the GPR signal, the radargram image produced can be affected by many factors especially the types of soil subsurface in the area where the underground utilities detection are done. This thesis describes a research project done to estimate, identify and analyse the types of soil subsurfaces in two different area in order to assess the GPR penetration capabilities in each of them. Furthermore, this research also involved the use of two GPR antenna frequency of 250 MHz and 800 MHz. (Fritzsche, 1995), showed through modelling that GPR signals at 900 MHz would be strongly attenuated in moist soils and in clay soils especially. A series of scanning are taken at each of the study area with different settings, where at the Kodiang sites, the study area are 10m x 15m and both types of GPR antenna frequency which is 250 MHz and 800 MHz were use. While at Bukit Kayu Hitam sites, the study area are 5m x 10m where both types of GPR antenna frequency which is 250 MHz and 800Mhz were use as well. This are done to compare the soil pattern of the study area and to see how different antenna frequency is affected in different types of soil subsurface. The processed radargram image are classified according to their textural features and geometry pattern of the profiles by visual interpretation of the interpreter. From the interpretation made, the radargram were manage to classified the soil pattern and characteristics together with aid of comparison from the Schematic Reconnaissance Soil Map as a strong references. Thus, based on the analysis, the soil pattern and characteristics which influence the potential of the pipeline laydown project by using GPR, the relevant types of the GPR data in terms of the soil pattern, and the image display as well as the 2D radargram model of the soil pattern and characteristics from GPR data for the pipeline laydown project at two different study area are obtained. Therefore, the results from the GPR and Soil Moisture Probe presented in this thesis conclude that the types of soil subsurface need to be considered and taken into account when doing GPR scanning as they affect the depth penetration and the radargram image produced as well as will affect the physical structure of underground pipelines utilities.

Table of Contents

CHAPTER ONE
INTRODUCTION

1.1 Research Background

Ground penetrating radar (GPR) is a high resolution electromagnetic technique that is designed primarily to investigate the shallow subsurface of the earth. Based on GPR technology, it is built for more effective coverage of the 3D space with the introduction of antenna arrays and multi-frequency systems (Vandenhaute, & Seuntjens,2014). Besides, GPR is a near-surface geophysical system that can provide a high degree of determination of the dielectric properties of the structures on the surface from a fewtens of meters (Journal et al., 2018). In order to get the accurate estimation of subsurface,the soil properties should examine especially relate to physical properties such as density, magnetic susceptibility and permeability, dielectric permittivity, electrical conductivity. In addition, GPR sensors offer an enhanced differentiation potential for soil disturbances. The resolution of radargram is really depend on frequency of antennawhere the frequency of antenna will decide the accuracy and depth of the feature can be detected. Smaller frequency of antenna will penetrate deeper but less detail of radargramresolution.

In addition, soils are the consequence of historical climate conditions associated with rainfall and temperature, the relief or slope of the location, the surrounding organisms, minerals content, and biological or chemical activity (Rhodes, 2012). Soils consist of a set of grains, such as mineral seeds and fragments of rock, with water and air in the grain vacuum in example such as a three-state porous structure. Soils are subjected to chemical and mechanical processes such as disintegration such as weathering, and erosion that define the soil's evolution, which is affected mainly by water presence. For instance, water influences the transportation of nutrients and manages the moisture content from colloidal particles of clay and humus such as organic matter by plant roots (Rhodes, 2012). The way the soil particles are rearranged may affect some local properties such as permeability like fine and coarse soils, strength due to fissures, stability from layers of different stiffness and strength by the presence of bonding influences (Inc, 2011). Underground pipelines may lie on recent entisols, developing inceptsols or mature geological deposits. The latter deposits exhibit a different mineral composition from the soil surface to the bedrock.