CHAPTER

7

2D RESISTIVITY METHOD IN LOCATING NEAR-SURFACE FRACTURE ZONES

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7.1 INTRODUCTION

A fault line is usually located deep inside the Earth's crust, reaching up to a few hundred metres. A fault line can move in certain directions and the type of fault is determined by the direction the fault shifted. When a fault line moves, all the soil layers and other materials above the fault line are shifted together, including the near-surface rock mass. As mentioned by Singhal and Gupta (2010), tectonic stresses which are related to the deformation of rocks are one of the causes of fracture zones in a rock body. The deformation of the fracture zones may be further extended by the weathering process. In a tropical country which has high intensity of rainfall throughout the year, weathering process occurs at a faster pace (Dan et al., 2014) than in any seasonal country. Hence, in Malaysia, the fracture zones will be further deformed rapidly.

Fracture zones are very significant in several fields, especially in civil and environmental engineering. It is a crack in the rock body which allows seepage to seep through the rock and reduce its engineering properties such as the strength of the rock. In civil engineering, a low-

strength rock body is not suitable to be the base or foundation of a structure. It can be said that fracture zones influence the competency of a rock body. Areas which have extensive and deep fractures are considered weak zones and not suitable for any construction as they are most probably filled with groundwater. On the other hand, areas with slight fractures and where the fractures are not deep are considered competent zones and better sites for engineering purposes. Therefore, the mapping of subsurface profiles and detecting fracture zones is important to locate the safest depth to lay the foundation of structures (Michael et al., 2013). Since the rock body in Malaysia is generally located more than five meters below the ground level, it is a challenge in determining the exact location of the fracture zones.

For decades, conventional methods such as boring have been used in investigating subsurface profiles (Ammar & Kamal, 2018; Mohamad et al., 2015) and determining the location of fracture zones. The boring method is done by drilling a borehole in several suspected areas where fracture zones are believed to be, to obtain the subsurface profile of a particular location. The conventional drilling borehole method is much more expensive and time-consuming besides providing information only in certain locations (George et al., 2008). Recently, another method which is called the geophysical method has sparked some interest in the civil engineering industry. There are several types of geophysical methods such as seismic reflection method, seismic refraction method, ground penetrating radar method, and electrical resistivity method. Latterly, there has been an increase in interest in electrical resistivity methods in Malaysia. The electrical resistivity method is preferred as it is a real-time and cost-saving method (Elis et al., 2019; George et al., 2008) rather than the borehole method which consumes a longer time to execute.

Hence, in this study, the electrical resistivity method will be used in obtaining the subsurface profile and determining the location of fracture zones in the study area. The present study is carried out to investigate the applicability of electrical resistivity tomography (ERT) in a subsurface investigation. The detailed objectives of the study are:

(1) To study ERT as one of the geophysical methods.

(2) To obtain a subsurface profile of the study area by using ETCR 3000B.

(3) To determine the location of near-surface fracture zones.

Based on the objectives, the scope of work is planned out whereby, this study will be conducted in Kolej Datin Seri Endon, Universiti Teknologi Malaysia using ETCR 3000B. The data processing will be done by using RES2DINV and the data will be interpreted in the form of histograms and pseudosections.

7.2 THE APPLICATION OF ELECTRICAL RESISTIVITY TOMOGRAPHY IN ENGINEERING GEOPHYSICS

The resistivity method is one of the oldest geophysical survey techniques and the most commonly used method in geophysical studies (Loke, 2000). However, in Malaysia, civil engineers are only starting to expose themselves recently in using resistivity methods in construction sites where various geological, geotechnical, and quality control problems might arise.

This type of applied geophysics is known as engineering geophysics. Local engineers apply this method of resistivity to determine the subsurface conditions for the construction of buildings and also to test the quality of man-made structures such as bridges, roads, and dams (Niederleithinger et al., 2015).

7.2.1 Electrical Resistivity Tomography

The origin of this method is due to the work of the Schlumberger brothers in 1920's (Loke, 2000). The resistivity method is a method which sends electrical current into the subsurface medium consisting of layers of materials with different individual resistivity (Herman, 2001) through two current electrodes and the resulting voltage difference at two potential electrodes is measured (Dafalla & Alfouzan, 2023; Loke, 2000).