PHYSICAL MODELING FOR DETERMINATION SLIP PLANE OF LANDSLIDE USING GEOELECTRICAL METHODE

Rahim Achmad[(1)], Rohima Wahyu Ningrum[(2)], Astuti Salim [(3)]

[1,2,3]Department of Physics Education, Faculty of Teacher Training and Education
Khairun University
Jalan Bandara Babullah, Akehuda, Ternate 97723, North Maluku, Indonesia

Corresponding author[(1)], Email: rahimachmad@mail.ugm.ac.id

ABSTRACT

A physical modeling has been conducted in a laboratory scale, to determine the slip plane of landslides. The physical model was installed in a container which is filled by landslide material (moist silty soil) and massive material as the host rock. The layer models are consist of six types of landslide situation then measured by geoelctrical method in centimetre scale. The result of geoelctrical measurement showed subsurface image by their own resistivity value. The host rock material has a high resistivity (range from: 100 to 150 Ωm) value, compared to resistivity values of landslide material(range from: 25 to 85Ωm). Border of difference layer creates a layer as known as slip plane of landslide. Thegeoelctrical image of subsurface also measured the depth of slip plane.

Key word: *geoelctrical, physical modeling, slip plane*

Abstrak

Telah dilakukan suatu pemodelan fisis skala laboratorium untuk menentukan bidang gelincir tanah longsor. Pemodelan fisis dilakukan pada bak model berisi material padat (massif) sebagai host rock dan di bagian atas lapisan tanah lempungan lembap. Model perlapisan dibuat dalam tiga tipe yang mencakup enam situasi saat kejadian longsor. Pengukuran geolistrik tanahan jenis dalam skala senti meter menunjukkan citra bawah permukaan yang membedakan materail host rock dan material longsor, berdasarkan nilai resistivitas tiap jenis batuan. Material host rock memiliki nilai resistivitas yang tinggi (70 to 250 Ωm) dibandingkan nilai resistivitas material longsor (25 to 85 Ωm). Batas perbedaan lapisan kedua batuan ini menciptakan bidang gelincir yang dapat ditentukan kdalamannya.

Kata Kunci: geolistrik, pemodelan fisis, bidang gelincir.

INTRODUCTION

The term “landslide” describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these.(usgs.gov, 2004). The materials may move by falling, toppling, sliding, spreading, spread and flow. Mass wasting refers to the down slope movement of Earth materials such as regolith or solid rock under the influence of gravity. Regolith is a term used to refer to all of the materials lying between unweathered rock below and the Earth’s surface above. It therefore includes weathered rock, soils, and unconsolidated deposits derived from flowing water, rain, and wind. When such material

rests on horizontal surfaces, then it is relatively stable.

However, if it rests on an inclined or sloped surface, then the degree to which the inclined or sloped surface varies from the horizontal, determines its stability. In such settings the resistance of the regolith to down slope motion is dependent upon its cohesiveness and its frictional resistance to motion. In addition, plant roots tend to bind the regolith, and therefore act as a stabilizing agent.

Naturally conditions of landslide can bedescribed as instability of rocks on the slope and can be modeled in a laboratory scale. Landslide material and host rock material are arranged in a container. These materials are set up due to landslide circumstances. The host rock located at the bottom and became sliding plane or surface of rupture, and landslide material is situated above the host rock.The materials then can be scanned using geoelctrical method, that give us the illustration of subsurface of rock layers. By applying this method the risk of landslides hazard can be reduced

METHOD OF RESEARCH

This research was performed by applying geoelectric method in the landslide container. The purpose of geoelectricalmethodis to determine the subsurface resistivity distribution by making measurements on the ground surface. From these measurements, the true resistivity of the subsurface can be estimated.(Loke, 2004). Kirsch (2009), discribe how to measure data in the field is shown in figure 1 below.

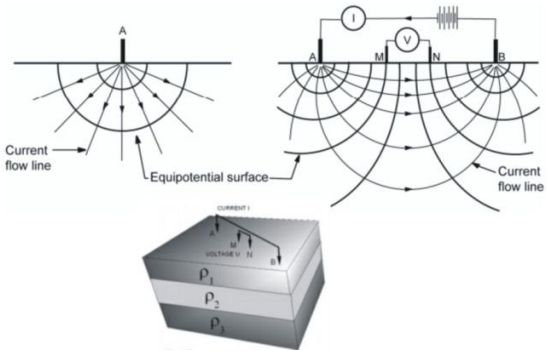

Fig.1 Electrode arrangement for apparent resistivity measurements(Kirsch, 2009)

The 2D measurement was carried out with ARES multi electrodes using Wenner-Schlumberger array. The depth of layer investigarion equal to the largest electrode spacing. The survey is usually carried out with a system where the electrodes are arranged along a line with a constant spacing between adjacent electrodes. This research apllied 2,3 m total length cable with 0.1 m distance each electrodes. The 2D resistivity measurement was completed, with maximum 0.3 m depth. The resistivity data from ARES were analyzed with Res2DInv computer programe by MH Loke (1999).Three measurement was conducted in the landslide container. The material (host rock and landslide material) are arranged as seen in the figure below.

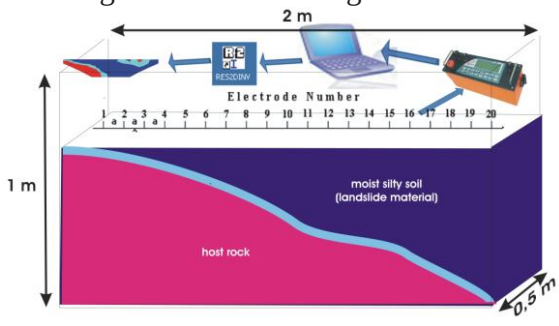

Figure 2.Layout measurement that include translational slide, rotational slide,debris avalance, debris flow, lateral spread and slump earthflow

RESULTS AND DISCUSSION

In order to apply geoelectrical method in this experiment, the arrangement of layers should be set up according to figure 1. The result of data experiment were then interpreted and processed by using Res2DInv computer programe by MH Loke (1999). The result of this interpretation showing the resistivity layers as well as their thickness as shown in figure 2.

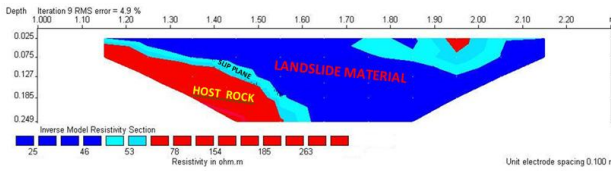

Fig.2 Wenner-Schlumberger configurationinverted resistivity

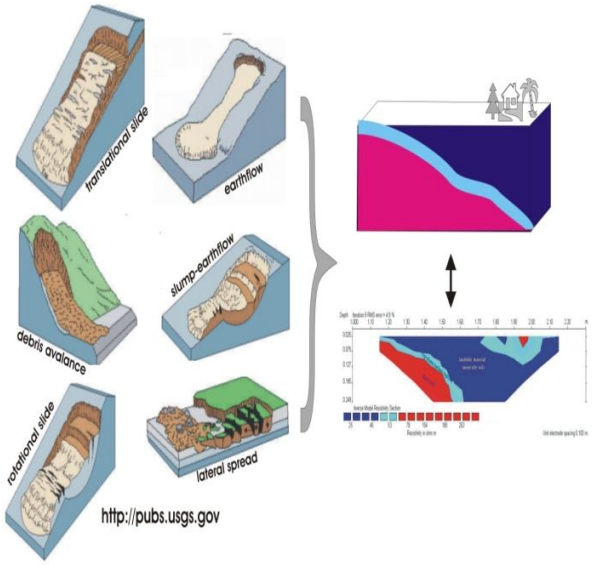

Fig.3 Types of landslide that can be covered by container model

In the figure above it is seen, the difference between landslide material (coloured blue) and host rock material (coloured red), based on the resistivity value. The landslide material withresistivity about 20 – 46 Ωm, and the host rock with resistivities about 70 – 270 Ωm. the layer between landslide and host rock as known as slip plane or surface rupture. This layer in certain circumstance also fall down together with landslide material because of its stability. In case of landslide, the material falls down has been saturated by water so it becomes heavy. The material which is still dry will became the host rock and slip of palne. The container model above (Fig. 2) covered some types of landside situation such as translational slide, rotational slide, lateral slide, slump earthflow, debris avalance, and earth flow

CONCLUTION

This research applied a simple model in determining the slip plane of landslide. Although there are many different types of landslides, geoelectric method can still be applied to detect slip plane. Determination of the slip plane can be done by comparing resisitivitas value of material that will become landslide material and the hostrock material. Material that will slip has low resistivity caused of rain water, and hostrock material has high resistivity value

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