UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Electrical and Electronic Engineering Technology

ASSESSMENT OF EARTH ELECTRODE RESISTANCE IN RESIDENTIAL BUILDING BY USING 3 POLE METHOD TEST

MUHAMAD AMIR SYAHIR BIN JAMAL ABANA

Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

2022

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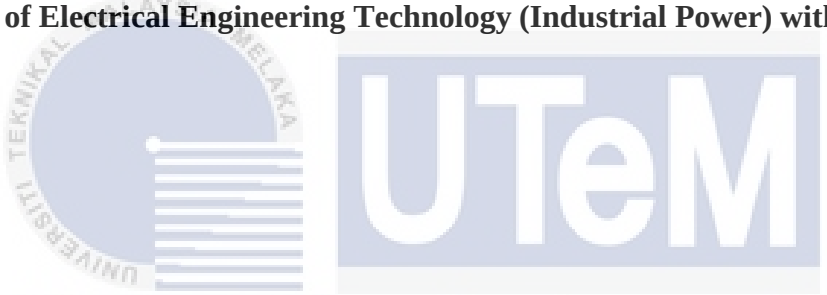
MUHAMAD AMIR SYAHIR BIN JAMAL ABANA

A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology (Industrial Power) with Honours



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FAKULTI TEKNOLOGI KEJUTERAAN ELEKTRIK DAN ELEKTRONIK

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Sesi Pengajian : 2022/2023

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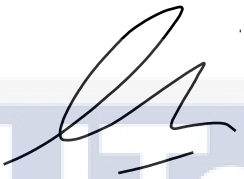
I declare that this project report entitled “Bachelor of Electrical Engineering Technology (Industrial Power) with Honours” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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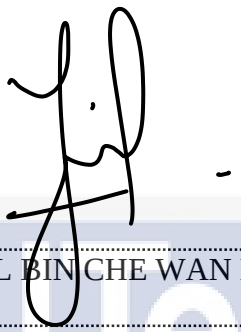
I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

Signature : 

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DEDICATION

I dedicate this project to my loving mother, Faudziah binti Che Pi, along with my supervisor, Sir Che Wan Faizal bin Che Wan Mohd Zalani, and my housemates, Muhammad Zhahir Zainal bin Zainal Abidin, Nasrullah Zikri bin Zulkiflee, Qadir Jailani bin Mahadzir, Muhammad Hafiz Zulfarhan bin Muhmmad Shah, Ammar Zakuan bin Mohd Razali, Alif Najmi bin Ahmad, Akmal Saufi bin Rosli for their continuous support and encouragement in completing this. I am expressing my gratitude to all of them because without them, I would not have progressed as far as I have.

ABSTRACT

An earthing system is an electrical system that provides a direct electrical connection to the Earth. The primary function of an earthing system is to ensure safety and avoid accident to people and equipment. The project objectives are to study the earth electrode system in Malaysia, Next, to inspect and investigate the earth resistance using 3 pole method test and evaluate and analyze the earth resistance in various location are following the regulation of Suruhanjaya Tenaga. The most common way to measure earth resistance is full 3 pole method, a number of tests are made at different distances of Potential and the resistance curve is plotted and also using simplified 3 pole method test. This method was used by Suruhanjaya Tenaga to measure resistance. Three measurements were taken at certain distances of P, and average calculation was used to figure out what the resistance was. The evaluation in the hill area received a very high reading. One possible explanation is that the ground at the top of the hill is drier than the soil at the bottom, which increases the resistance to the flow of electric current. The earth's resistance was observed to be high regardless of the fact that the house had only recently been completed built, so the assumption was made that maybe because lack of knowledge when doing research, moisture of soil, temperature or the contractor who did the wiring of this house may have taken safety for granted. Overall, the main purpose of this assessment was to determine whether the earth electrode system was providing an adequate level of protection against electric shock and other hazards.

ABSTRAK

Sistem pembumian ialah sistem elektrik yang menyediakan sambungan elektrik terus ke Bumi. Fungsi utama sistem pembumian adalah untuk memastikan keselamatan dan mengelakkan kemalangan kepada orang dan peralatan. Objektif projek adalah untuk mengkaji sistem elektrod bumi di Malaysia, Seterusnya, untuk memeriksa dan menyiasat rintangan bumi menggunakan ujian kaedah 3 kutub dan menilai dan menganalisis rintangan bumi di pelbagai lokasi mengikut peraturan Suruhanjaya Tenaga. Cara yang paling biasa untuk mengukur rintangan bumi ialah kaedah 3 kutub penuh, beberapa ujian dibuat pada jarak Potensi yang berbeza dan lengkung rintangan diplot dan juga menggunakan ujian kaedah 3 kutub yang dipermudahkan. Kaedah ini digunakan oleh Suruhanjaya Tenaga untuk mengukur rintangan. Tiga ukuran telah diambil pada jarak P tertentu, dan pengiraan purata digunakan untuk mengetahui apakah rintangan itu. Penilaian di kawasan bukit mendapat bacaan yang sangat tinggi. Satu penjelasan yang mungkin adalah bahawa tanah di bahagian atas bukit adalah lebih kering daripada tanah di bahagian bawah, yang meningkatkan rintangan kepada aliran arus elektrik. Rintangan bumi diperhatikan adalah tinggi tanpa mengira rumah itu baru sahaja siap dibina, jadi andaian mungkin kerana kurang pengetahuan semasa membuat kajian, kelembapan tanah, suhu atau kontraktor yang melakukan pendawaian ini. rumah mungkin telah mengambil keselamatan begitu sahaja. Secara keseluruhannya, tujuan utama penilaian ini adalah untuk menentukan sama ada sistem elektrod bumi menyediakan tahap perlindungan yang mencukupi terhadap kejutan elektrik dan bahaya lain.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to God for giving me good health, strength, and the opportunity to gain my knowledge successfully to complete this Final Year Project (FYP) within a given time. I would like to thank my parents for their support and patient in waiting for me to finish my degree. I also express my sincere thanks to my friends for giving timely pieces of advice to this research project. They are sharing a lot of knowledge related to proceed this research project. It helps me to complete this research project more efficiently.

Secondly, I am expressing my sincere appreciation and thanks to my beloved supervisor Encik Che Wan Faizal bin Che Wan Mohd Zalani for his helping, teaching, monitoring, support, and contribution. He has guided and assisted me patiently during two semesters in session 2022/2023. Also, I sincerely appreciate and thank Ts. Zaihasraf bin Zakaria and Ts. Adlan bin Ali as my panel research for sharing his knowledge and experience in Research Methodology. Their suggestions have been useful for me to proceed well this research project.

Finally, I would like to thank to my parents, family members and friends for their inspired me and prayer during the period of my study. Last but not least, I want to thank me for believing in me, I want to thank me for doing all this hard work. I wanna thank me for having no days off and I wanna thank me for never quitting.

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LIST OF SYMBOLS

V	-	Voltage
Hz	-	Hertz
mm	-	Millimeter
cm	-	Centimeter
m	-	Meter
mA	-	Milliampere
D	-	Distance
ft	-	Feet
Ω	-	Ohm
P	-	Potential
C	-	Current

LIST OF ABBREVIATIONS

RCD	-	Residual Current Device
ELCB	-	Earth Leakage Circuit Breaker
RCCB	-	Residual Circuit Current Breaker
SPD	-	Surge Protection Device
PPE	-	Personal Protection Equipment
AC	-	Alternative Current
TNB	-	Tenaga Nasional Berhad
FEM	-	Finite Element Method

CHAPTER 1

INTRODUCTION

1.1 Background

Since electricity was discovered a long time ago, grounding is important part to any electrical system whenever large or small. Grounding was used as a safety measure to keep people from in contact with electrical hazards by accident. The circuits that connect electrical devices to the ground are called the grounding system or earthing system. They are part of the electrical system. The safety and electromagnetic compatibility of the installation might be affected by the choice of earthing system. The International Electrotechnical Commission's (IEC) recommendations on earthing systems are widely followed by governments around the world [1]. In addition to electric power systems, other systems may require grounding for safety or function. Lightning rods may be installed on tall buildings as part of a lightning protection system. A good grounding system should have a program for regular inspection and maintenance to keep it working well. Periodic maintenance is addedto make sure that the grounding system doesn't break down or get destroyed by accident. This is done by choosing the right material for the electrodes and installing them correctly. The way these electrodes work depends on things like the soil's type, composition, conductivity, moisture level, temperature, and so on.

However, circuits can break or malfunction just like everything else. It is possible for electricity to leak from a circuit due to damaged or broken wires. When a current flows,it can either shock you, harm your property, or cause a fire. This is prevented using grounding wires. Even if the closed-circuit system is broken, voltage always takes the shortest route to neutrality. This path of low resistance is provided by grounding wires. Theyare connected to a grounding rod that is buried in the ground beneath your transmission lines. The grounding wire "catches" any stray voltage and transfers it to the ground, where it can'tharm you. This is an important safety feature. That’s why it is very important to maintain grounding resistance 10 ohm or less for domestic installations.

Although the material is an excellent conductor and can be used as a grounding electrode, the lifespan of the material is a serious issue. Regardless of the material, a thicker coating provides better corrosion protection, resulting in a longer life expectancy for the material. Grounding system performance can be evaluated using the Finite Element Method (FEM) [2], which provides a more accurate and compact result than engineering formulas for the fast design of grounding systems, as well as being adaptable to large and complicated systems. It is difficult to determine which grounding system electrode is best for safe electrical grounding and effective operation.

Figure 1.1 Electrical grounding wire [8]

It is important to ground electrical circuits to prevent electrical accidents. An increase in voltage can cause electricity to jump across the system's wires during a power surge. Thiscan a fire, damage to equipment or even damage people surrounding if it is not grounded. Proper grounding protects your home's electrical system even in the event of a large power surge or lightning strike. To keep the voltage in your system from arcing into other conductive elements like water or metal, it is necessary to use grounding. Grounding wires help your appliances live much longer and perform better by preventing voltage overload and damage. Modern residential electrical systems are more protected by grounding than by any other method. The most important part of earthing is dealing with safety regulations. Earthing requirements for electrical system are well define in ELECTRICAL REGULATIONS, 1994. Earthing is important since it has to do with safety Tenaga Nasional Berhad (TNB) is responsible for the system's earthing, but the customer is responsible for the earthing of his own equipment [3]. On the other hand, in the event of an earth fault, sufficient current can flow quickly enough to activate the circuit protection devices. There are many reasons to install a grounding system. The most important purpose, however, is to

protect people. Protection of structures and equipment from accidental contact with energized electrical lines is a further concern. The grounding system must provide optimum protection against electrical system failures and lightning strikes. To maintain its efficiency,a proper grounding system must be inspected and serviced regularly. To ensure that the grounding system resists corrosion or accidental damage, good design, material selection, and installation techniques aid in ongoing or periodic maintenance. As a result, only minor repairs are required to maintain the structure's functionality over time.

The grounding system is used for three major factors [4]. The first one is to protect against over voltage. High voltages in the electrical distribution system can be caused by lightning, line surges, or accidental contact with higher voltage lines. In order to get around the building's electrical system, grounding is required. This keeps damage to a minimum. Second, the grounding system helps keep the voltage stabilize. It is known that an electrical system has more than one source of voltage. If there is no common point of reference for all of these voltage sources, it would be very hard to figure out how they relate to each other. Also, the earth is the most common conductive surface, so it was used from the beginning of electrical distribution systems as a standard for almost all electrical systems. The third reason for a grounding system is to provide a path for current so that overcurrent devices can work better. This is the most important reason for having a grounding system, because it keeps people and property safe in case something breaks. Electricity is an important part of everyone's day-to-day lives. Since being exposed to electricity by accident can harm you, any electrical wiring or installation needs to have proper earthing [5]. Most of us think of the earth electrode as a way to keep from getting shocked by electricity by accident, but that's not true. To protect people and equipment from earth faults, it's important to have a proper earth connection and other protection devices to disconnect the electric supply within the specified time.

1.2 Problem Statement

The main purpose of the earthing system is to ensure that the circuit protecting device operates properly. If a live conductor accidentally touches a metallic part because the insulation has broken, the current will flow through the earth conductor and not through the person's body in a properly earthing system. Earthing would not work if the earth's resistance were high because the human body is the path with the lowest resistance. Earthing is an important part of both high-voltage and low-voltage power networks. The earthing system is the whole set of actions taken to connect a part that conducts electricity to the ground. Not only does poor earthing cause unnecessary downtime, but it is also dangerous to people and their property. When RCD/ELCB/RCCB are employed as the circuit protecting device, earthing resistance of less than 10 ohm is usually sufficient to ensure that the RCD/ELCB/RCCB work properly. The lightning earthing system must be segregated from the installation earthing system and have a resistance of not more than 10 ohms. The goal is to have an earthing resistance of less than 10 ohm. In general, the lower ground resistance, the safer the system. Earth leakage current can lead to accidental personal safety or equipment and building protection. Because of the many benefits [6] that related to earthing,it has been a requirement in many nations to offer earthing in all types of installations, including those found in residential and industrial installations. Only a few research papers have been published in recent years that attempt to evaluate how successful earthing systems are. Many accidents [7] have occurred because of negligence in the interest of earthing. This study was conducted due to lack of awareness about the importance to have good earthing in residential buildings. By observing the data obtained at real situation problem, the resistanceof the earth electrode at an unidentified location will be evaluated using the 3 -pole method known after this study.

1.3 Project Objective

To achieve the aim of study, these objectives must follow to be fulfill:

i) To study the earth electrode system in Malaysia

ii) To inspect and investigate the earth resistance using 3-pole method test

iii) To evaluate and analysis the earth resistance in various location of residential building are following the regulation of Suruhanjaya Tenaga.

1.4 Scope of Project

The analysis is scaled down to be more specific, based on the following objectives, to havea clear view of the main points. The following are the scopes of this research:

i) This project is a study on the earth resistance in selected residential buildings are following the regulation in Malaysia.

ii) The resistance measurement was conducted at various suitable locations in Sungai Petani, Kedah with different types of experiment.

iii) The earth electrode resistance test is repeated at least 10 times or more and the resistance curve is plotted.

iv) An earth resistance tester was used to measure the earth's resistance.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter begins with an explanation of what an earthing system is and why it is necessary to implement. The next step is to choose the best material for the earth electrode. Characteristics such as good conductivity of electricity and resistance to rusting in soil over time. Then, soil resistivity and the earthing system are very responsible for the effective and correct operation of any electric power system's generation, transmission, and distribution. Other than that, we will discuss the main objective of earthing and hazard that could happen when facing with electricity. Next, the types of earthing system that commonly used and the method to reduce the earth resistance if it is higher than regulation. Methods to measure the earth resistance also been discussed. A lot of research from previous study were state that earthing system is important to prevent any damage on equipment and human.

2.2 What is earthing system

Electrical installations in residential building are becoming very important and it's significant to use modern ways to be installed. Earthing is a very important part of a power system, especially since most faults are caused by the ground or by storms and lightning. The terms "earthing" and "grounding" mean the same thing. It is a way to connect equipment to the earth's mass. The main goal of earthing is to reduce the amount of potential transient overvoltage, which is required by standards for the safety of people and to help detect and isolate faults rapidly [8]. Several ground electrodes are driven into the earth in different places to make a connection to the ground. Installing an earth electrode is an important part of making sure that an earthing system works well. Professionals who design and install electrical systems need to think about several different grounding systems for any building or structure they work on. Local Regulation [9] must be met by all earthing systems. Ground resistances can only be measured with special test equipment and technique. The fall-of-potential principle is used by almost all instruments and for equipment was commonly used earth tester such as Megger Earth Tester Kit. The objective of protective earthing is to keep parts of equipment that are not live from having too much voltage on them, which could cause shocks. The non-live parts are connected to electrodes or parts that are already grounded.