Journal of Mechatronics and Artificial Intelligence
Homepage: http://ejournal.upi.edu/index.php/jmai/
p-ISSN 3062-729X e-ISSN 3048-4227

Feasibility Analysis of Lightning Grounding System at SAMSAT Soekarno-Hatta Building Bandung City Based on PUIL Standard

Mochmamad Raihan Febriana[1], Linda Faridah[1,*]

[1]Electrical Engineering SIliwangi University"
*Correspondence author email: lindafaridah@unsil.ac.is

ARTICLE INFO

Article History:

Submitted/Received 01 Oct 2024
First Revised 01 Nov 2024
Accepted 25 Nov 2024
Publication Date 01 Dec 2024

Keywords:
Grounding System,
Resistance,
SAMSAT Bandung

ABSTRACT

Protection from surges caused by lightning is an important concern in public buildings, including in SAMSAT Soekarno-Hatta Building, Bandung City, which functions as a service center with high electricity consumption and various sensitive electronic equipment. An adequate grounding system is required to conduct excess current to ground to protect electronic devices and ensure occupant safety. This study aims to evaluate the feasibility of the lightning grounding system at the Bandung SAMSAT Building based on the PUIL 2000 safety standard, which stipulates that the grounding resistance value must be below 5 ohms to achieve optimal protection. The grounding resistance measurement is carried out using an earth tester, which is able to measure the actual resistance of the building grounding system. Based on the measurement results, the resistance value obtained is 4.44 ohms. This value meets the requirements of PUIL 2000 and indicates that the grounding system in the building is within safe limits. In addition to resistance measurements, visual observations were also made to ensure the physical condition of grounding components, such as lightning rods and connecting conductors, which were found to be in good condition although there were signs of light corrosion on the conductors. The conclusion of this research shows that the grounding system in the Soekarno-Hatta SAMSAT Building meets the eligibility standards for lightning protection. This has positive implications for the protection of buildings and electronic equipment from the risk of lightning strikes. The suggested recommendation is routine maintenance to maintain the performance of the grounding system, especially in the area of corroded conductors, so that the resistance value remains within safe limits.

1. Introduction

Offices, malls, factories and houses must require a grounding system as a security system, the safety of equipment and surrounding people from various surge factors such as from lightning disturbances [1] [2]. The grounding system is a system that connects the electric current from the equipment conductor with the installation system connected to the ground [3], [4], [5]. PUIL 2000 stipulates that in electrical installations, the recommended standard grounding resistance value is below 5 Ohm. This value aims to be an important reference in designing and maintaining an effective grounding system in accordance with applicable regulations [6].

Lightning protection systems are an essential component in the design of building infrastructure, especially in public buildings that have high activity and sensitive electronic equipment [7] [8]. Indonesia, with its tropical climate, has a high lightning frequency, so the risk of lightning strikes on buildings is significant [9] [10] The SAMSAT Soekarno-Hatta Building in Bandung City, as a public service facility, requires an effective grounding system to protect electronic equipment and ensure occupant safety from lightning-induced surges. The grounding system functions to channel the electric current from a lightning strike to the ground through a low resistance path, so that the surge can be channeled safely without endangering the surrounding equipment and humans [11], [12] Safety standards in Indonesia, as regulated in the General Requirements for Electrical Installations (PUIL) 2000, stipulate that the grounding resistance value should be below 5 ohms to provide optimal protection [13], [14]. However, implementation in the field shows variations in the quality and effectiveness of grounding systems, and not all public buildings meet the recommended standards. Factors such as soil conditions, electrode types, and installation methods affect the resulting grounding resistance levels, so further research is needed to measure the effectiveness of grounding systems in public buildings.

Research related to grounding systems and grounding resistance has shown that resistances below 5 ohms are capable of providing sufficient protection against lightning strikes. Previous studies emphasize that buildings that do not meet this standard are at risk of damage to electronic equipment and increase the danger to occupant safety. Despite this, the effectiveness of the application of the PUIL 2000 standard in public buildings in Indonesia has received less attention, especially in the context of application to government buildings that use a lot of sensitive electronic equipment. This has prompted the need for further evaluation to ensure that public buildings have a proper grounding system in accordance with safety standards. This study aims to evaluate the feasibility of the grounding system in the SAMSAT Soekarno-Hatta Building in Bandung City by measuring the grounding resistance value and comparing it with applicable safety standards. The resistance measurement was carried out using an earth tester, which allows the measurement of the actual resistance value of the building grounding system to be compared with the threshold value of 5 ohms set by PUIL 2000. In addition to measuring resistance, this research will also make visual observations of grounding system elements, such as lightning rods, conductors, and grounding electrodes, to assess their physical condition and effectiveness in delivering current to the ground. With this research, it is expected that clear information can be obtained about the condition of the grounding system in the Soekarno-Hatta SAMSAT Building, whether it meets the required safety standards or not. The hypothesis proposed is that the grounding system in this building has a resistance value below 5 ohms, so it is considered safe and feasible to provide protection against lightning strikes. If the measurement results show a resistance value that exceeds the threshold, improvement recommendations will be suggested to increase building safety and reduce the risk of damage due to lightning surges.

2. Methods

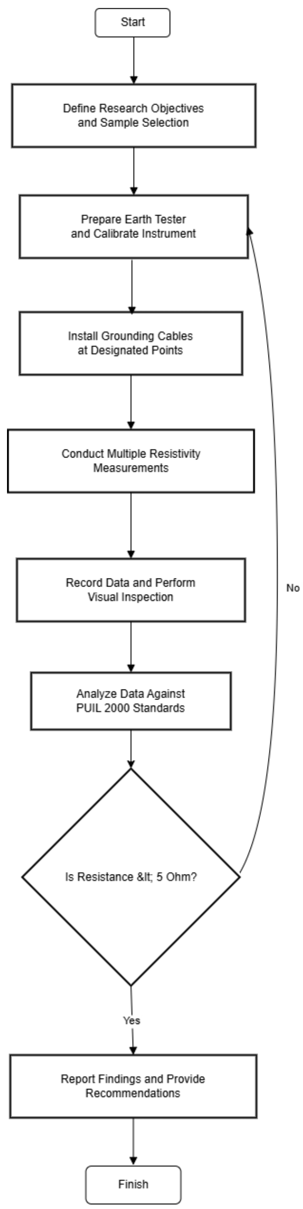

Figure 1. Flowchart Research

This study used a quantitative experimental design to evaluate the feasibility of the lightning grounding system at the SAMSAT Soekarno-Hatta Building in Bandung City, with the aim of measuring the effectiveness of the grounding system based on the PUIL 2000 standard which requires a grounding resistance of less than 5 ohms. This study began with the establishment of research objectives and sample selection, which was purposively selected at the SAMSAT Soekarno-Hatta Building. This building was chosen because it has characteristics that match the research, namely the use of sensitive electronic devices that require good grounding protection.

The next step is the preparation of the measuring device, which is an XYZ earth tester model that has been calibrated to ensure its accuracy. This tool was chosen because it meets the measurement standards required to produce valid and consistent data. After the tool preparation, grounding cables were installed at predetermined points around the building, with a cable configuration that follows the standard: green cable at the Earth terminal, yellow cable at the P terminal, and red cable at the C terminal. These cables were placed at a distance of 5-10 meters to maximize the accuracy of the measurement results. After wiring, resistance measurements were taken at selected grounding points. Measurements are taken several times at several points to obtain an average resistance value that can represent the condition of the grounding system as a whole. The results of these measurements are then carefully recorded, and completed with a visual inspection of the grounding components, such as lightning rods, conductors, and grounding electrodes, to ensure that all components are in good condition and do not experience corrosion or damage that can affect resistance.

The next stage is data analysis, where the grounding resistance value obtained is compared with the PUIL 2000 standard, which is below 5 ohms. The analysis is done quantitatively to determine whether the grounding resistance of this building is within safe limits or not. The results of this analysis are then interpreted; if the resistance is below 5 ohms, then the grounding system is considered to meet the standard and is feasible as lightning protection. If not, recommendations for improvement will be provided.Finally, the research results are compiled in a report that includes the resistance value, the condition of the grounding components, and recommendations for improvement (if needed). This report is expected to provide a comprehensive overview of the feasibility of the grounding system in the Soekarno-Hatta SAMSAT Building, as well as ensuring optimal protection against the risk of lightning strikes.

3. Results and Discussion

3.1. Analysis of Grounding Resistance Value Based on PUIL 2000 Standard

Table 1 : Measurement Point

Measurement Point	Resistance (Ohm)
Point 1	4,35
Point 2	4,44
Point 3	4,42
Point 4	4,47
Point5	4,4

Table 1 show The measurement values at the five grounding points in the SAMSAT Building show a resistance range between 4.35 to 4.47 ohms, with an average of 4.44 ohms. All these values are below the maximum limit of 5 ohms, which is in accordance with the **PUIL 2000** standard. Based on these results, the SAMSAT Building grounding system is confirmed to meet the lightning protection requirements for public buildings, as it has a low enough resistance to efficiently conduct lightning current to ground.

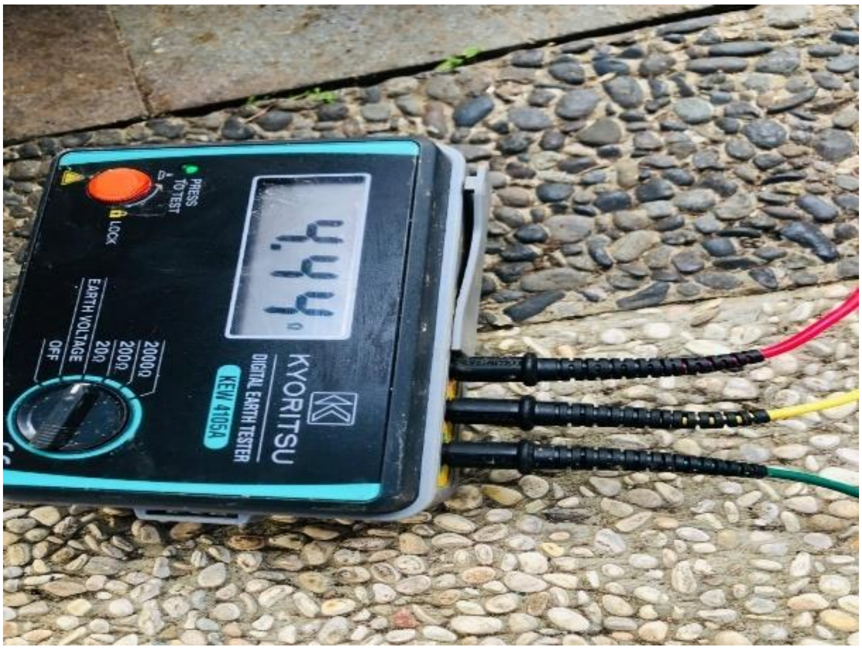

Figure 1. Measurement Results

The grounding resistance value obtained from the SAMSAT Building, which is 4.44 ohms, is below the maximum limit of 5 ohms set by **PUIL 2000** as a standard for lightning protection in public buildings. This standard is based on the assumption that lightning currents can flow to the ground efficiently if the grounding resistance is low, thus preventing damage to equipment and maintaining occupant safety. This resistance value of 4.44 ohms places the SAMSAT Building grounding system in the safe category, so that protection against lightning strikes can be achieved properly. Technically, this shows that the grounding components are capable of delivering excess current with low resistance, which means that the grounding connection has optimal electrical conductivity and does not experience significant resistance that can cause current surges.

3.2. Effect of Corrosion on Grounding Conductors and its Long-term Effects

Figure 2. Condition of Grounding

Although the current resistance value was within safe standards, visual observation of the grounding conductors showed signs of corrosion. Corrosion of the conductors can be a serious problem in the long run, as corrosion slowly reduces the electrical conductivity of the conductors, which in turn can increase the grounding resistance. An increase in resistance can reduce the effectiveness of the grounding in delivering current to the ground, which means that protection against lightning will decrease. If corrosion is left untreated, the resistance of the grounding system could exceed the required safe limit of 5 ohms. Therefore, it is important to carry out periodic maintenance to remove corrosion and prevent resistance increases. This will not only maintain the performance of the grounding system, but also extend the life of the existing grounding components.

3.3. Impact of Environment and Soil Quality on Grounding Resistance

In addition to the quality of the grounding components, the environmental conditions and soil type around the grounding electrodes also play an important role in determining the resistance value. Soils with high mineral content or moist soils usually have better electrical conductivity than dry or sandy soils. In the case of the SAMSAT Building, the low resistance value indicates that the soil environment supports the effectiveness of the grounding system. However, soil conditions may change over time due to environmental factors, such as seasonal changes, rainfall, and human activities around the grounding area. Changes to the soil structure or mineral composition of the soil can result in an increase in resistance, which decreases the ability of the grounding system to handle lightning currents. Therefore, regular monitoring of the soil and environmental conditions around the grounding electrodes is also an important step to maintain the effectiveness of the system.

3.4. Research Contribution to Grounding Standards and Practices in Indonesia

This research emphasizes the importance of maintaining grounding systems in public buildings such as the SAMSAT Building to ensure optimal protection against lightning risks. The results of this research provide empirical evidence that resistance values below 5 ohms, as per the PUIL 2000 standard, are an effective benchmark for building protection. This confirms the relevance of the standard in the Indonesian context, which has high lightning intensity in various regions.These findings may contribute to the development of more specific standards in the context of lightning protection, particularly for buildings with sensitive electronic equipment. The PUIL 2000 standard can be improved by including additional recommendations, such as maintenance frequency, corrosion handling techniques, as well as more detailed guidance on the ideal soil composition for grounding systems. These implications are important for practitioners in the electrical field and building management to ensure that the lightning protection system is always in optimal condition.

Based on the results and this in-depth analysis, several recommendation steps can be taken to ensure the effectiveness of the SAMSAT Building grounding system is maintained, Routine maintenance and visual inspection are essential for maintaining safe resistance levels in grounding systems, particularly in conductors susceptible to corrosion. Regular inspections, conducted every six months or annually, can detect early signs of damage, enabling prompt repairs before resistance levels increase. Additionally, if a significant rise in resistance is observed, the number and quality of grounding electrodes may need to be enhanced. This can involve increasing the number of electrodes or selecting electrode materials that are more resistant to corrosion, ensuring the resistance value remains within safe limits. Monitoring soil conditions around the grounding electrodes is also crucial, particularly in areas with fluctuating soil composition. Adjusting soil moisture levels or adding conductive materials like salt can help control resistance if it begins to rise due to changes in soil quality. Together, these practices contribute to the effective and safe operation of grounding systems

4. Conclusion

Based on the research that has been conducted on the lightning grounding system in the SAMSAT Soekarno-Hatta Building, Bandung City, it can be concluded that the grounding resistance value obtained is 4.44 ohms. This value is below the maximum standard of 5 ohms set by PUIL 2000, which indicates that the grounding system meets the safety requirements and is effective to protect the building from the risk of surges due to lightning strikes. These results indicate that the current grounding system can be relied upon to conduct lightning currents to ground, thereby reducing potential damage to electronic equipment and increasing the safety of building occupants. Visual observations of the grounding components also show that the condition of the lightning rod and grounding electrodes is quite good, although there is slight corrosion on the conductors that needs to be considered in the long term. This research emphasizes the importance of regular maintenance on the grounding system to keep the resistance value within safe limits. The recommendations include regular maintenance of the grounding conductors, monitoring of ground conditions, and upgrading the system if the resistance value increases in the future. With these measures, it is expected that the grounding system in SAMSAT Building can continue to function optimally and provide effective long-term protection. This research also reinforces the relevance of the PUIL 2000 standard for buildings in Indonesia that are at high risk of lightning strikes, and can serve as a reference for other public building management in adopting grounding systems that comply with safety standards

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