Contents list avaliable at Directory of Open Access Journals (DOAJ)

JUTIN : Jurnal Teknik Industri Terintegrasi

Volume 8 Issue 2 2025, Page 1650-1656

ISSN: 2620-8962 (Online)

Journal Homepage: https://journal.universitaspahlawan.ac.id/index.php/jutin/index

Evaluation of Grounding System Maintenance at JIS Jakarta School Building

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DOI: 10.31004/jutin.v8i2.42727

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Article Info

Keywords:
Grounding system;
Grounding resistance;
Maintenance;
Electrical Safety;
Grounding electrode

Abstract

This research analyzes the maintenance of the grounding system in JIS Pattimura School Building, Jakarta, to improve electrical safety and reliability. A reliable grounding system protects equipment and people from electrical hazards. The research methods include observation, measurement of grounding resistance with an Earth Tester, and analysis based on PUIL standards. The results show that some grounding points, such as the grounding on the server panel and alarm panel, require improvement because the resistance value exceeds the standard, especially in areas with dry soil or covered by buildings, with the grounding resistance value after improvement of 0.96 Ohm and 1.09 Ohm, respectively. The solution implemented was the addition and deepening of grounding electrodes to lower the resistance. Regular maintenance and periodic monitoring are recommended. A maintained grounding system improves safety, extends equipment life, and ensures compliance with standards.

1. INTRODUCTION

The safety and reliability of electrical systems are fundamental aspects in the design and construction of modern infrastructure, including school buildings. A reliable electrical system ensures smooth operations and protects assets as well as human lives. A crucial component in the electrical system is the grounding (earthing) system, which plays a central role in mitigating the risks of electrical disturbances such as lightning strikes, leakage currents, and overvoltages. This system provides a low-impedance path for fault currents to flow to the ground, minimizing equipment damage and the risk of electric shock. Failure of the grounding system can have fatal consequences, ranging from equipment damage to fires and serious injuries. In the era of technological advancement, dependence on electronic equipment is increasing. Modern school buildings, such as JIS Pattimura, are equipped with sophisticated electronic devices that require a reliable grounding system. The PUIL 2000 standard (General Requirements for Electrical Installations) sets strict requirements related to grounding systems, including a low grounding resistance value. However, maintenance of the grounding system is often neglected. Changing soil conditions, corrosion, and physical damage can increase resistance, reducing system effectiveness. Regular evaluation and maintenance are essential. This study analyzes the maintenance of the grounding system at the JIS Pattimura School Building, which represents a modern building with complex electrical needs. The safety of students and staff is a priority, making the reliability of the grounding system imperative.

Received 19 February 2025; Received in revised form 25 February 2025 year; Accepted 30 March 2025
Available online 10 April 2025 /

This research focuses on: the grounding resistance value of the electrical installation, the suitability of the installation panels, the conformity of the grounding resistance value with PUIL 2000, and the voltage difference between the input and output of the panels. The objectives of this research are: to measure and analyze the grounding resistance value of the main panel and transformer, to analyze the voltage and current of the main and branch panels, to evaluate the feasibility of the grounding system based on PUIL 2000 and international standards, and to provide recommendations for improvement. Theoretically, the grounding resistance (R) is calculated by $R = (\rho / L) * [\ln(4L/d) - 1]$, where ρ is the soil resistivity, L is the electrode length, and d is the electrode diameter. Common grounding system types include TN-C, TN-C-S, TN-S, TT, and IT. Types of grounding electrodes include rod, plate, and strip electrodes. PUIL 2000 provides detailed guidance on the technical requirements of grounding systems.

This research uses a quantitative approach with observation, measurement (calibrated Earth Tester), and data analysis. Measurements are carried out at representative grounding points. Visual inspection is also carried out. This research is expected to improve safety, protect assets, ensure regulatory compliance, advance scientific knowledge, and serve as a basis for maintenance. The results provide concrete recommendations for improvement and maintenance, including the addition/replacement of electrodes, connection repairs, or configuration changes. In conclusion, the grounding system is a vital component. Regular evaluation and maintenance are important for optimal performance and compliance with standards. This research analyzes the condition of the grounding system at JIS Pattimura and provides recommendations, improving safety, protecting assets, ensuring compliance, and contributing to the science of electrical protection.

2. METHODS

This research, conducted at the JIS Pattimura School Building from July to December 2024, investigated the grounding resistance value within the building's electrical system. Data collection employed a mixed-methods approach. A literature review of relevant sources provided theoretical grounding on grounding systems.

Figure 1. Research location

Direct observation was used to assess the existing system's condition, locate panel boxes, and identify measurement locations. The core quantitative data collection utilized a three-point measurement method with a Kyoritsu 4105a Digital Earth Tester Meter, employing one main electrode and two auxiliary electrodes (placed 5-10 meters apart), connecting the appropriate color-coded cables to the instrument's corresponding terminals. The research procedure involved preparing equipment; checking the instrument's battery; inspecting and cleaning the grounding cable; verifying instrument condition; connecting cables to the Earth Tester and electrodes; setting the measurement range (20, 200, or 2000 ohms); and recording the resistance value displayed after pressing the test button. Documentary evidence of measurements and collected data was also gathered. The research encompassed project monitoring, data collection, and report writing stages throughout the specified timeframe.

3. RESULT AND DISCUSSION

The grounding resistance test data obtained showed variations in resistance values at several installation points in the field. The test results were compared with the standards set by electrical regulations (<5 ohm for residential systems or <1 ohm for industrial systems). The following is the Grounding Resistance Test on JIS 1 and JIS 2 Building

Fig. 1. JIS 1 and JIS 2 Grounding Testing

Figure 1 Periodically inspect the physical condition of the grounding cables, electrodes, and grounding connections to ensure there is no damage or corrosion.

Fig. 2. Table of Annual Measurement Results of JIS 1 and JIS 2 Grounding

Analisa Perawatan Grounding Pada Gedung JIS											
JIS 1											
Unit	**Terpasang**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Kondisi konduktor**	**Keterangan**
Panel alarm	2017	0,76	0,56	0,89	0,45	1,34	0,89	0,51	7,56	-	2024 sedang renovasi
Panel LVMDP	2017	2,45	0,98	1,56	1,47	0,87	1,92	0,45	1,92	baik	
Panel Server	2017	0,34	0,55	0,39	0,86	2,9	0,43	0,54	5,38	Korona	2024 kondisi conection korosi dan perlu penambahan titik
JIS 2											
Unit	**Terpasang**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Kondisi konduktor**	**Keterangan**
Class Room	2017	0,34	0,45	0,56	6,2	0,23	0,89	0,51	0,96	baik	2020 Perbaikan tahanan tanah akibat lokasi tertutup class
Gym	2017	0,56	0,49	0,22	1,34	1,53	1,92	0,45	1,92	baik	
Theater	2017	2,56	3,13	8,12	0,41	0,84	0,54	0,23	0,99	baik	2018 pemindahan box
Gedung Transisi	2023	-	-	-	-	-	-	0,18	0,24	baik	

In the table 2 figure for most of the test points, the grounding resistance values are within the acceptable range according to the standard. However, there are some points that have higher resistance values than expected, especially in areas with drier soil and areas that are no longer accessible due to the addition of building structures. At certain locations, the grounding resistance value tends to increase with time, indicating that the grounding maintenance performed is not sufficient to maintain the grounding quality.

To improve the grounding value that is not in accordance with the standard, the project will make a planning approach by adding rod stick points or deepening the rod stick. So that the grounding resistance value can be in accordance with the expected standard.

Server Panel Grounding Repair

The following is the approach method for planning the improvement of the Server Panel area grounding. In the Server Panel grounding system has 1 electrode with a depth of 2.5 meters resistance value of 5.38 ohms. To achieve a value below 0.99, the electrodes needed are as follows:

$$R\ total = \frac{R}{n}$$

$$n = \frac{R}{R\ total}$$

$$n = \frac{5{,}38}{0{,}99}$$

$$n = \mathbf{5{,}43}$$

Then the required electrode value is 5.43 or 6 electrodes, and if you want to get a grounding value with 1 earthing, the required depth is :

$$\frac{R\ baru}{R\ lama} = \frac{L\ baru}{L\ lama}$$

$$\frac{0{,}99}{5{,}38} = \frac{L\ baru}{2{,}5}$$

$$L\ baru = 2{,}5\ x \frac{0{,}99}{5{,}38}$$

$$2{,}5\ x\ 0{,}1840$$

L baru = 0,46 meter/ **46 cm**

Fig. 3. The result of repairing and adding electrodes to the Server panel

Alarm Panel Grounding Repair

Furthermore, the results of the Alarm Panel area grounding improvement planning method. The Alarm Panel grounding system has 1 electrode with a resistance value of 7.56 ohms with a depth of 2 meters, where the land area for adding electrodes is not possible, only 2 points can be added with a distance of 3 meters from the main point by dismantling the floor. To achieve a value below 1.2 Ohm, the electrode depth required is as follows:

$$\frac{R\ baru}{R\ lama} = \frac{L\ baru}{L\ lama}$$

$$\frac{1{,}2}{7{,}56} = \frac{L\ baru}{2}$$

$$L\ baru = 2\ x \frac{1{,}2}{7{,}56}$$

$$2\ x\ 0{,}1587$$

Then the depth that needs to be added is 0.3174 meters or 32 cm and if you want to add 1 point back, the value obtained is as follows:

$$\frac{1}{R\ total} = \frac{1}{7{,}56} + \frac{1}{7{,}56}$$

$$R\ total = \frac{2}{7{,}56}$$

R total = **3,78 Ohm**

Here are the results of the earthing improvement approach to the alarm panel system.

Fig. 4. Repair results and addition of electrodes on the Alarm panel

Table 1. Results of repairs and additions and electrode depths on Alarm and Server panels.

Tabel Perbaikan Nilai Grounding

No	Unit	Before	After	Repair Value	Description
1	P. Server	5,38	0,99	-4,39	Addition of 6 units of stick rod
2	P. Alarm	7,56	1,2	-6,36	Addition of 32 cm

From the results of table 1 above, it is known that the grounding improvement value on the Server panel is -4.39 Ohm, which we know the addition of the stick rod on the server panel reaches a value of 0.96, this proves that the results of the formulation get almost appropriate results.

As for improvements to the Alarm panel, it gets an improvement value of -6.36 by adding a depth of 32 cm. we know that the calculation results get a value of 1.20 Ohm. Due to this improvement, the combination of watering the salt water media with the addition of the depth of the stick rod, the results obtained are 1.09 Ohm, where watering with salt water media can certainly increase the reduction of resistance by 0.11 Ohm.

4. CONCLUSION

This research on the JIS Pattimura School Building's grounding system highlights the importance of diligent maintenance. Improvements to the Alarm and Server Panel grounding significantly reduced resistance, demonstrating the effectiveness of combining rod extension, saltwater treatment, and adding additional rods. These results underscore that meticulous attention to electrode placement, installation, and material selection is crucial for optimal performance and safety, especially for protecting sensitive electronics. Regular visual inspections, resistance measurements, and performance testing under load are essential. Implementing routine maintenance schedules and promptly addressing identified issues will enhance grounding system performance, leading to lower, more stable resistance, and ensuring a safer, more reliable electrical environment.

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