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AugusCompliance of Building Wiring Installations in Public Infrastructure Buildings: Implications for Electrical Safety and Energization in Surigao del Sur

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ABSTRACT

Ensuring the safety and compliance of electrical systems is critical in maintaining the integrity of public infrastructure, particularly in government project buildings. Using a descriptive-evaluative research design, this study evaluated the electrical wiring systems of public infrastructure buildings in the Province Surigao del Sur, Philippines, describing their current state and assessing their compliance with Philippine Electrical Code (PEC) standards. The Megger test results showed varying levels of insulation resistance across the buildings, with New Building 1 and Old Building 1 exhibiting generally good readings, but some circuits fell into the "Fair" category. New Building 2 mostly had high readings, but a few circuits showed lower resistance, indicating the need for maintenance, while Old Building 2 displayed robust insulation with minor areas needing attention. The evaluation of wiring installations against Philippine Electrical Code (PEC) standards revealed compliance in New Building 1 but identified undersized wires and incorrect breaker ratings in New Building 2, Old Building 1, and Old Building 2, posing safety risks. The study also reviewed the requirements for building energization by SURSECO II, emphasizing the importance of following a structured process involving zoning permits, electrical plans, fire safety certifications, and personal documentation. Regular maintenance and insulation testing, wiring installations reviewed and upgraded to meet PEC standards, and strict adherence to SURSECO II's requirements are all recommended to ensure the safety, reliability, and compliance of the electrical systems in public infrastructure buildings.

Keywords: Compliance, building wiring installation; Philippine Electrical Code; assessment; electrical safety; energization

INTRODUCTION

Electrical system plays a crucial role in ensuring the safety, functionality, and efficiency of electrical systems in residential, commercial, and industrial structures (National Academies of Sciences, Engineering, and Medicine, 2017). Proper wiring significantly reduces the risk of electrical fires, short circuits, and electrocution, as faulty wiring remains a leading cause of electrical fires due to outdated or improperly installed systems (Falvo, & Capparella, 2015). Research indicates that adherence to wiring standards and regular maintenance greatly minimize electrical hazards, making installations safer for occupants (Kulor et al. 2024). Additionally, well-designed wiring installations optimize energy distribution, reducing losses and enhancing overall system efficiency. Studies suggest that proper electrical wiring can lower energy consumption by improving the performance of appliances and systems (Han & Lim 2010).

Smart wiring solutions, such as structured cabling systems, support energy-efficient technologies like automated controls and smart lighting, contributing to sustainable building practices (Metallidou et al. 2020). Investing in high-quality wiring installations also proves cost-efficient, preventing frequent repairs and replacements, which saves costs in the long run. Research shows that proper initial installation is far more economical than addressing future maintenance issues caused by substandard work (Dahal & Dahal 2020). Moreover, correct wiring practices extend the lifespan of electrical systems by protecting appliances and electronics from power surges and fluctuations (National Academies of Sciences, Engineering, and Medicine 2017).

Compliance with building codes and regulatory standards, such as the National Electrical Code (NEC), is essential for ensuring safety and reliability (Boss et al. 2009). The Philippine Electrical Code (PEC) follows the fundamental principles of the NEC, incorporating globally recognized best practices in electrical installation, grounding, and insulation resistance (Todoc 2018). While the NEC serves as a universal benchmark, the PEC adapts these guidelines to local conditions, addressing factors such as climate, infrastructure, and available materials. This alignment ensures that electrical systems in the Philippines meet international safety standards while remaining practical for local implementation. Failure to comply with these regulations can lead to legal liabilities, penalties, and increased insurance costs (Keller 2010). Adhering to these standards not only protects lives and property but also enhances the overall safety and reliability of electrical systems (Bukhanan & Abu 2017).

Furthermore, modern technologies heavily rely on electrical infrastructure, and proper wiring supports the integration of advanced systems such as home automation, high-speed internet, and security systems (Gungor et al. 2011). A well-installed wiring system is foundational for adopting smart grid technologies and renewable energy sources, which are critical for developing sustainable and future-ready buildings (Greacen 2015). Therefore, building wiring installation is not just about connecting circuits; it is a vital component that impacts safety, efficiency, and the potential for technological advancements in today's built environment.

However, wiring installation faces several issues that can significantly impact safety and efficiency. One of the primary concerns is the presence of outdated or non-compliant wiring, particularly in older buildings. Many of these structures still rely on obsolete wiring systems that fail to meet current safety standards, increasing the risks of electrical fires, shocks, and unreliable power supply. Non-compliance often results from using substandard materials or outdated installation methods that do not align with modern electrical codes (Bissett 2022). Older wiring types, such as aluminum or knob-and-tube systems, are especially prone to overheating and degradation, posing significant hazards (Baechler et al. 2012).

Improper installation and poor workmanship are also major issues in building wiring (Reason, & Hobbs 2017). These problems often stem from unqualified or untrained electricians who take shortcuts during installation, leading to loose connections, overloaded circuits, and inadequate insulation. Poorly executed installations frequently result in electrical failures, costly repairs, and increased downtime, particularly in commercial and industrial settings (Malhotra et al. 2020). The lack of regular maintenance and inspections further exacerbates these issues, as undetected problems such as frayed wires, corrosion, and damage from pests can lead to serious electrical incidents. Research highlights that regular maintenance is critical for identifying potential issues early, yet it is often neglected in many buildings (Sarbini et al. 2021).

Ensuring electrical safety and compliance in public infrastructure is a growing challenge due to substandard materials, inadequate planning, and rising energy demand. Inferior wiring components increase the risk of malfunctions and fires (Asibeluo et al. 2023; Kumar & Balachander 2023), while poorly designed systems lead to overloads and costly modifications (Shafique et al. 2020). The widespread use of IoT devices has further strained power systems, necessitating safer wiring installations (Cheah et al. 2024). Climate-driven energy demand also exacerbates outages, emphasizing the need for sustainable energization strategies (Enteria & Calipayan 2023). Energy-efficient technologies, such as semi-transparent photovoltaic panels, can reduce consumption while generating electricity (Jelita et al. 2024). Effective building design decisions influence energy performance, making strategic planning crucial (Wei et al. 2023). The integration of Building Information Modelling (BIM) enhances compliance and safety in electrical installations (Zulkifli et al. 2023). Policymakers must address these challenges to ensure reliable and sustainable electrical infrastructure (Enteria & Calipayan 2023).

Environmental and physical factors further contribute to wiring issues. Exposure to moisture, extreme temperatures, and chemicals can degrade wiring insulation and components, resulting in malfunctions and safety hazards (Lokanath et al. 2019). Buildings in high-humidity or flood-prone areas are particularly vulnerable to such damage (Salimi, & Al-Ghamdi 2020). Physical damage caused by rodents, construction activities, or accidental impacts also compromises the integrity of wiring systems (Mohd Nizam Ong et al. 2022). These issues underscore the importance of proper installation, regular maintenance, and adherence to safety standards to ensure reliable and safe building wiring systems.

With that, the Philippine government and related agencies have taken several actions to address issues associated with building wiring installations, driven by a long-term commitment to energy efficiency and safety

(Rudnick, & Velasquez 2019). Since 1975, the government has emphasized energy conservation and safety through various declarations and strategic plans addressing energy use. Republic Act 7638 or known as the Department of Energy Act of 1992, is responsible for ensuring public safety by preventing and suppressing hazards and destructive effects of fire incidents (Republic Act No. 7638, 1992).

On the other hand, the Philippine Electrical Code (PEC) serves as a critical regulatory standard aimed at minimizing the risks of electric shocks, fires, and explosions due to electrical installations (Institute of Integrated Electrical Engineers of the Philippines, Inc., 2017). To ensure electrical safety, most electrical cooperatives in the Philippines require an electrical inspection before building energization. This inspection includes assessing the wiring installation, verifying the correct wire sizes and safety protections, and ensuring that load computations adhere to PEC standards. A key element of this inspection is the insulation resistance test, which confirms that installations are safe and compliant (ANECO 1977).

In addition to enforcing regulations, the government has also been proactive in providing technical support and public guidelines that emphasize the dangers and hazards associated with electricity, particularly when improperly connected or used. These efforts aim to raise awareness of electrical safety among the public, despite the many benefits and comforts electricity provides (Campbell 2019). The DOE, alongside local governments and private organizations, conducts public awareness campaigns on electrical safety, educating the public about proper wiring and adherence to safety standards (Republic Act No. 7638, 1992).

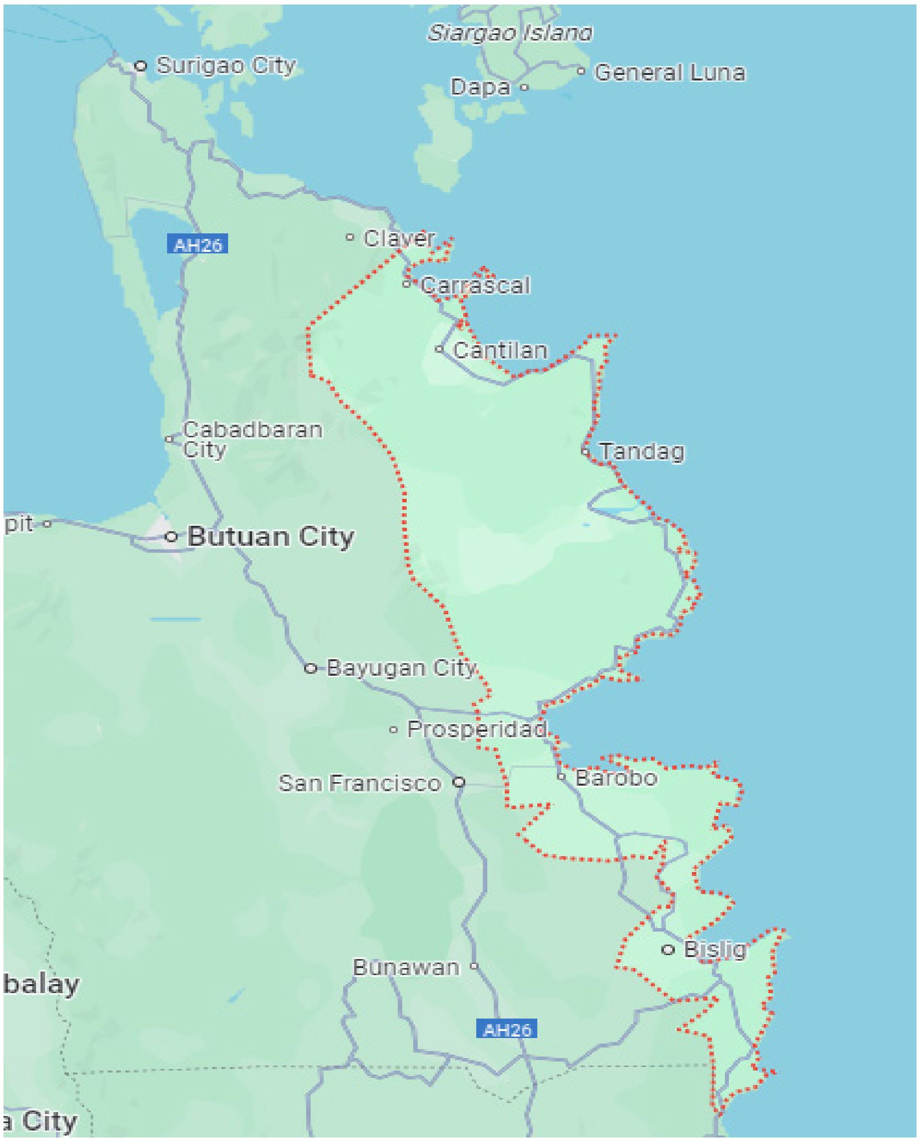

FIGURE 1. Map of Surigao del Sur

Despite existing measures and regulations, significant challenges persist in ensuring safe and compliant electrical installations in the Philippines. In a radio interview, BFP spokesperson Supt. Annalee Carbajal-Atienza reported that fire incidents increased by 12.9 percent in January and February, with 2,103 cases compared to 1,863 during the same period in 2021. The main causes of fires in the Philippines include faulty electrical connections, electrical overloading, old wiring, improper connections, and poor or damaged wire quality, highlighting the importance of understanding the root causes to prevent further damage. (Phelps Dodge Philippines, 2022). Non-compliance with safety standards and substandard practices continue to be prevalent due to corruption, insufficient monitoring, and a lack of accountability among contractors and builders (Owino 2022). Inspections are often inadequate, particularly in remote and underdeveloped areas where regulatory oversight is weaker (Hossain, 2018). Resistance to modernizing and updating wiring standards further complicates the situation, especially in older buildings where upgrading electrical systems is costly and disruptive (Campbell 2012).

Preliminary observations of public infrastructure buildings like in schools and hospitals in Surigao del Sur reveal that these national challenges are evident at the local level. Figure 1 illustrates the map of Surigao del Sur (see figure 1.). Francisco, (2022) added that frequent electrical fluctuations reported in many government facilities. These fluctuations are primarily caused by overloading and faulty wiring systems, which not only disrupt the regular functioning of electrical systems but also pose serious safety risks, including potential electrical fires (Martinka 2022). The situation is particularly problematic in government schools, where unreliable electrical connections often lead to brownouts, voltage drops, and other power issues that severely impact the operation of essential equipment and learning environments.

In some extreme cases, newly completed buildings have never had a reliable electricity supply, raising serious concerns about the quality of electrical work and the adequacy of inspections before project completion. These problems highlight the need for stricter adherence to electrical codes and more rigorous oversight during construction to ensure the safety and functionality of government infrastructure as emphasized by Navarro and Latigar 2022). The combination of overloading, faulty wiring, and inadequate oversight not only disrupts the daily operations of these government buildings but also endangers the safety of their occupants. Without immediate corrective action, these electrical issues could escalate into widespread electrical failures or catastrophic events, such as fires as pointed by BFP spokesperson Supt. Annalee Carbajal-Atienza (Phelps Dodge Philippines, 2022).

To this effect, the researcher is determined to conduct an assessment of the electrical wiring system of the public infrastructure buildings in the Province Surigao del Sur, Phlippines. It is crucial to address these flaws in electrical installation by enforcing compliance with established codes, enhancing inspection protocols, and investing in the modernization of electrical systems. These measures are essential to ensure that all public infrastructure buildings in the region meet the necessary safety and operational standards, protecting both public assets and the people who rely on them. More so, the results of the study will be of high contributions to the administrations, stakeholders, employees, community, and electric cooperatives in maintaining a safe and hazard-free working environment.

METHODOLOGY

DESIGN

The study employed a descriptive-evaluative research design, integrating quantitative and qualitative methods to assess the electrical installations of selected public infrastructure buildings in Cantilan, Surigao del Sur. The quantitative aspect involved measuring insulation resistance, while the qualitative component focused on assessing wiring installations and reviewing the electric cooperative's requirements for building energization. This approach allowed for a systematic evaluation of electrical safety and compliance with the Philippine Electrical Code (PEC) standards.

PARTICIPANTS

The participants included 10 electric cooperative personnel, such as electrical engineers, inspectors, and technical staff, who were directly involved in the building energization process. Public infrastructure buildings were carefully selected based on age, frequency of use, and history of electrical issues. Older buildings were considered due to potential risks from outdated wiring, while frequently used buildings, such as government offices and schools, were prioritized due to their higher electricity consumption and need for reliable electrical systems.

RESEARCH LOCALE

The research was conducted in Cantilan, Surigao del Sur, Philippines, focusing on public infrastructure buildings. Figure 1 illustrates the location of the monitored new and old buildings. These buildings were chosen to reflect a range of electrical installation conditions, from newer constructions to older structures requiring compliance upgrades. The study aimed to assess the safety and efficiency of electrical systems in these buildings and determine whether they met PEC standards.

FIGURE 2. Actual Location of Monitored Buildings in Surigao del Sur
Source: Photo courtesy of Google Map.com

INSTRUMENTS

To collect data, the study used various instruments. A Megger Insulation Resistance Tester was used to measure insulation resistance readings at key electrical points such as main distribution panels, branch circuits, outlets, and switches. Direct observations and on-site inspections were conducted to evaluate wire size, circuit protective ratings, and wiring installation quality. The study also reviewed key documents from the electric cooperative, including application forms, compliance checklists, and procedural guidelines related to building energization. Additionally, interviews were conducted with electric cooperative personnel to gather insights on energization procedures, compliance issues, and industry best practices.

PROCEDURE

The data gathering procedure involved multiple steps. Insulation resistance testing was conducted at various electrical points, with recorded readings compared to PEC standards. Wiring assessments were performed through direct observation, document reviews, and inspections, focusing on wire sizing, breaker compatibility, and installation quality. Interviews with electric cooperative personnel provided additional insights into building energization requirements and compliance challenges. Public buildings were selected based on criteria such as age, frequency of use, and history of electrical issues to ensure a representative sample. Additionally, a one-year monitoring period was conducted, where an electrical engineer installed and managed equipment to track insulation resistance fluctuations and overall electrical performance.

DATA ANALYSIS

For data analysis, descriptive statistics such as mean and standard deviation were applied to insulation resistance readings, allowing for a comparison with PEC standards. Additionally, thematic analysis was used to evaluate wiring assessments and interview responses, identifying key compliance gaps and safety concerns. The combination of these methods provided a comprehensive evaluation of the electrical systems in public infrastructure buildings and their alignment with industry safety standards.

RESULTS AND DISCUSSION

The Megger test reading results in Table 1 showcase a comprehensive assessment of insulation resistance across various circuits within different locations, each categorized based on standardized megohm measurements. In the New Building 1, lighting outlet circuits (L.O) exhibit a range of insulation resistance levels. For instance, 1-L.O displays a "Very Good" insulation resistance of 1000 megohms, while 2-L.O, 4-L.O, 6-L.O, and 8-L.O is categorized as "Good" with reading ranging from 125 to 150 megohms, and circuits 3-L.O, 5-L.O, and 7-L.O, fall into the "Fair" category with readings of 75 megohms. Unfortunately, the absence of a specific reading for the main circuit introduces uncertainty about its insulation condition, hindering a comprehensive evaluation of the overall insulation integrity within the department.

Conversely, the New Building 2 demonstrates consistently high insulation resistance readings across circuits. The MAIN Circuit and Convenience Outlet (C.O) circuits 1 to 12 all exhibit "Very Good" insulation resistance at 1000 megohms, ensuring robust insulation integrity. However, lighting outlet circuits 20 through 24 fall into the "Fair" category with readings ranging from 25 to 75 megohms, prompting further investigation into potential maintenance needs to uphold electrical safety standards The Actual Reading of Insulation Resistance of the Old and New Buildings

TABLE 1. Megger Test Reading Result

LOCATION	CIRCUIT	L1-N (Reading in Megohms)	RESULTS
New Building 1	1- Lighting Outlet	1000 megohms	Very Good
	2- Lighting Outlet	150 megohms	Good
	3- Lighting Outlet	75 megohms	Fair
	4- Lighting Outlet	150 megohms	Good
	5- Lighting Outlet	75 megohms	Fair
	6- Lighting Outlet	150 megohms	Good
	7- Lighting Outlet	75 megohms	Fair
	8- Lighting Outlet	125 megohms	Good
New Building 2	Main	1000 megohms	Very Good
	1 – Convenience Outlet	1000 megohms	Very Good
	2 – Convenience Outlet	1000 megohms	Very Good
	3 – Convenience Outlet	1000 megohms	Very Good
	4 – Supply	1000 megohms	Very Good
	5 – Convenience Outlet	1000 megohms	Very Good
	6 – Convenience Outlet	1000 megohms	Very Good
	7 – Convenience Outlet	1000 megohms	Very Good
	8 - Convenience Outlet	1000 megohms	Very Good
	9 - Convenience Outlet	1000 megohms	Very Good
	10 - Convenience Outlet	1000 megohms	Very Good
	11- Convenience Outlet	1000 megohms	Very Good
	12 - Convenience Outlet	1000 megohms	Very Good
	20 - Lighting Outlet	75 megohms	Fair
	21 - Lighting Outlet	50 megohms	Fair
	22 - Lighting Outlet	75 megohms	Fair

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	23 - Lighting Outlet	50 megohms	Fair
	24 - Lighting Outlet	25 megohms	Fair
Old Building 1	Main	1000 megohms	Very Good
	1 – Convenience Outlet	1000 megohms	Very Good
	2 – Convenience Outlet	1000 megohms	Very Good
	3 – Convenience Outlet	25 megohms	Fair
	4 – Lighting Outlet	150 megohms	Good
Old Building 2	Main	1000 megohms	Very Good
	1 - Lighting Outlet	1000 megohms	Very Good
	2 - Convenience Outlet	75 megohms	Fair
	3 – Convenience Outlet	1000 megohms	Very Good

Note: Legend: Very Good: 1,000 megohms (1 GΩ) or higher
Good: 100 megohms to 999 megohms (100 MΩ to 1 GΩ)
Fair to Marginal: 10 megohms to 99 megohms (10 MΩ to 100 MΩ)
Poor: Below 9 megohms

The Old Building 1 showcases predominantly high insulation resistance across circuits, with the MAIN Circuit, C.O circuits 1 to 3, and L.O circuit 4 all categorized as "Very Good" or "Good." However, C.O circuit 3 falls into the "Fair" category with an insulation resistance reading of 25 megohms. This highlights the need for careful monitoring and potential corrective action, despite the majority of circuits being in excellent condition. Lastly, the Old Building 2 predominantly exhibits high insulation resistance readings, with the MAIN Circuit and C.O circuit 1 -L.O categorized as "Very Good." C.O circuit 2 falls into the "Fair" category with an insulation resistance reading of 75 megohms. This underscores the importance of targeted maintenance efforts in the identified circuit to ensure sustained optimal performance and adherence to safety standards.

ASSESSMENT OF THE BUILDING WIRING INSTALLATION FOLLOWING THE PEC STANDARDS

The assessment of building wiring installations, as per the Philippine Electrical Code (PEC) standards, is presented in Table 2, providing a detailed overview of loads, protective ratings, and wire sizes across different locations within New Building 1, New Building 2, Old Building 1, and Old Building 2.

The results from Table 2 reveal significant compliance and safety issues across the electrical installations in the evaluated buildings, particularly concerning breaker ratings and wire sizes. This highlights a critical need for adherence to the Philippine Electrical Code (PEC) standards, which are crucial for ensuring electrical safety and efficiency.

TABLE 2. Load, Protective Rating, and Size of Wire

LOCATION	CIRCUIT	LOAD (WATTS)	BREAKER (AMP.)	WIRE SIZE	PEC Standard
	Main		60A	5.5 mm2	Not Compliant
	1- Lighting Outlet	580	30A	3.5 mm2	Compliant
	2- Lighting Outlet	1,900	30A	3.5 mm2	Compliant
	3- Lighting Outlet	1,900	30A	3.5 mm2	Compliant
New Building 1	4- Lighting Outlet	520	30A	3.5 mm2	Compliant
	5- Lighting Outlet	700	30A	3.5 mm2	Compliant
	6- Lighting Outlet	1,200	30A	3.5 mm2	Compliant
	7- Lighting Outlet	1,200	30A	3.5 mm2	Compliant
	8- Lighting Outlet	700	30A	3.5 mm2	Compliant
	Main		150A	50 mm2	Compliant
New Building 2	1 – Convenience Outlet	2250	20 A	3.5 mm2	Compliant
	2 – Convenience Outlet		60 A	3.5 mm2	Not Compliant
	3 – Convenience Outlet	2250	20 A	3.5 mm2	Compliant

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	4 – Supply		40 A	3.5 mm2	Not Compliant
	5 – Convenience Outlet	4,000	20 A	3.5 mm2	Compliant
	6 – Convenience Outlet		20 A	3.5 mm2	Compliant
	7 – Convenience Outlet	3,000	40A	5.5 mm2	Compliant
	8- Convenience Outlet	3,000	20A	5.5 mm2	Not Compliant
	9- Convenience Outlet	3,000	40A	5.5 mm2	Compliant
	10- Convenience Outlet	3,000	20A	5.5 mm2	Not Compliant
	12- Convenience Outlet	4,000	20A	5.5 mm2	Not Compliant
	20- Lighting Outlet	500	20A	3.5 mm2	Compliant
	21- Lighting Outlet	780	20A	3.5 mm2	Compliant
	22- Lighting Outlet	1,200	20A	3.5 mm2	Compliant
	23- Lighting Outlet	1,200	20A	3.5 mm2	Compliant
	24- Lighting Outlet	780	20A	3.5 mm2	Compliant
Old Building 1	Main		40 A	5.5 mm2	Not Compliant
	1 – Convenience Outlet	350	30 A	3.5 mm2	Compliant
	2 – Convenience Outlet		15 A	3.5 mm2	Compliant
	3 – Convenience Outlet	1250	30 A	3.5 mm2	Compliant
	4 – Lighting Outlet	400	30 A	3.5 mm2	Compliant
Old Building 2	Main		60 A	5.5 mm2	Not Compliant
	1 - Lighting Outlet	1600	15 A	3.5 mm2	Compliant
	2 - Convenience Outlet	1000	20 A	3.5 mm2	Compliant
	3 – Convenience Outlet	800	15 A	3.5 MM2	Compliant

In New Building 1, all circuits, including the main and sub-circuits, comply with PEC standards, demonstrating the importance of correct wire sizing and breaker ratings. This adherence ensures safe and efficient power distribution, reducing risks such as overheating and fires. Proper combinations of 30A breakers and 3.5 mm² wires across various circuits illustrate a sound electrical design, reflecting well on the building's safety measures

Conversely, New Building 2 exhibits numerous non-compliance issues that jeopardize safety and operational efficiency. For example, sub-circuits like 2-C.O and 4-Supply are equipped with 60A and 40A breakers, respectively, but use only 3.5 mm² wires, which are significantly undersized for these loads. This misalignment with PEC standards suggests a serious disregard for safety protocols, potentially leading to dangerous overheating and circuit failures ((Institute of Integrated Electrical Engineers of the Philippines, Inc., 2017).). The issues in circuits 8-C.O, 10-C.O, and 12-C.O, where 20A and 40A breakers are paired with insufficient 5.5 mm² wires, further illustrate a systemic problem that cannot be ignored. Such discrepancies endanger both the building's structural integrity and the safety of its occupants. Immediate corrective measures, such as upgrading wire sizes and adjusting breaker ratings, are essential to mitigate these risks and ensure compliance with safety standards (Campbell, 2012).

Similarly, Old Building 1 and 2 presents drawback areas where the main circuit's 40A and 60A breaker respectively paired with a 5.5 mm², wire fails to meet PEC compliance. The standard ampere rating for a main circuit breaker should typically range from 60A to 100A depending on the load and wire size (Institute of Integrated Electrical Engineers of the Philippines, Inc., 2017). This non-compliance highlights a common yet preventable oversight that compromises safety. However, the sub-circuits in Old Building 1 largely comply with PEC standards, indicating that adherence is achievable with proper planning and installation practices. In addition, Old Building 2 demonstrates full compliance across circuits 1,2, and 3, proving that even older infrastructures can meet PEC standards through careful management and adherence to guidelines.

These findings underscore the critical need for stringent adherence to PEC standards across all electrical installations. Non-compliance not only compromises safety and efficiency but also exposes buildings to increased risks of electrical failures and hazards (Ahern et al. 2023). Immediate actions, such as upgrading wire sizes and re-evaluating breaker ratings, are essential to ensure that electrical systems are safe and capable of handling their designated loads., the safety of the infrastructure and its occupants can be significantly enhanced, through addressing these issues, protecting against preventable electrical dangers.

Moreover, to assess the compliance of public buildings with the Philippine Electrical Code (PEC), an electrical inspection was conducted, focusing on wiring installations, circuit protection, and conduit security. The inspection aimed to identify common electrical issues that could compromise safety and efficiency. The findings highlight areas of concern in both old and new buildings, particularly regarding wire sizing, breaker ratings, and wiring organization. Below are the key observations based on the inspection.

1. New Building 2 – Main Electrical Panel: Undersized wires (3.5 mm^2) were found connected to 60A and 40A breakers, leading to potential overheating and circuit failure.
2. New Building 2 – Sub-Circuits: Breakers rated at 20A and 40A were paired with insufficient 5.5 mm^2 wires, failing to meet PEC standards for load capacity.
3. Old Building 1 – Main Circuit: The 40A breaker was connected to a 5.5 mm^2 wire, which does not meet safety requirements. However, sub-circuits were properly rated and followed PEC guidelines.
4. Old Building 2 – Main Circuit: A 60A breaker was also paired with a 5.5 mm^2 wire, which could cause overheating under high load conditions.
5. Old Building 2 – Sub-Circuits: Circuits 1, 2, and 3 were compliant with PEC standards, showing that older buildings can achieve proper safety measures with correct installation and maintenance.
6. Various Locations – Wiring Routing and Security: Several areas had unorganized wiring, making troubleshooting difficult. Some conduits were missing or loosely secured, exposing wires to physical damage

The findings indicate that non-compliance with PEC standards, particularly in wire sizing and circuit protection, is a significant issue in both old and new buildings. Undersized wires paired with high-rated breakers pose a risk of overheating and electrical failures (Davidson, 2024; Gabdulin & Ro, 2020). Improperly secured conduits and disorganized wiring further increase hazards, making maintenance and troubleshooting more challenging (McCabe & Flynn, 2024; Alghoul et al. 2018). However, compliance observed in certain areas, particularly in well-maintained buildings, highlights the importance of proper installation and regular inspections. Adhering to PEC guidelines and implementing routine maintenance can effectively mitigate risks and ensure safe electrical systems (Li et al. 2024; Tagao et al. 2024).

SURSECO II REQUIREMENTS FOR BUILDING ENERGIZATION

The process for building energization in accordance with the requirements set by Surigao del Sur Electric Cooperatives (SURSECO) II involves a sequential flow of steps designed to ensure compliance with safety regulations and local ordinances (see Figure 3). This systematic approach is critical for maintaining safety and reliability in electrical installations. Before energization, buildings must secure the necessary permits, zoning approvals, and certifications to verify compliance with electrical safety standards. These requirements help prevent faulty wiring, undersized conductors, and improper circuit protection, which are common causes of electrical failures. Furthermore, SURSECO II's guidelines align with the Philippine Electrical Code (PEC), ensuring that all installations meet technical standards before being connected to the power grid. This includes verifying the adequacy of wire sizes, breaker ratings, conduit security, and overall system integrity.

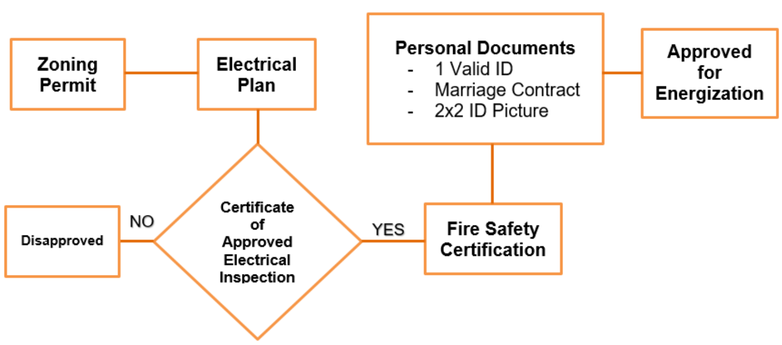

FIGURE 3. Flow for Building Energization (SURSECO II)

Based from the records, the initial step involves securing a Zoning Permit from the local zoning office. This document confirms that the proposed building or structure adheres to local zoning regulations, which is essential for ensuring that developments are aligned with urban planning and land use policies (Asomaniwaa, 2022). Following the acquisition of the Zoning Permit, the next step is preparing and submitting the Electrical Plan and Permit to the Municipal Engineer. This plan must adhere to specific standards and gain approval before proceeding with electrical installation, reflecting the importance of adhering to technical and safety standards as outlined in the Philippine Electrical Code (PEC) (Institute of Integrated Electrical Engineers of the Philippines, Inc., 2017).

Simultaneously, obtaining a Fire Safety Certification underscores the importance of fire prevention measures. This certification, which requires a Certificate of Approved Electrical Inspection, ensures that the electrical components meet safety standards and have been inspected by relevant authorities. Such measures are crucial for preventing electrical hazards and enhancing overall building safety.

To facilitate the administrative process, the applicant must present personal documentation, including a valid ID, a Marriage Contract, and a 2x2 ID picture. These documents serve as proof of identity and legal status, ensuring that all regulatory and administrative requirements are met. A unique aspect of this process is the requirement for a Certificate of Seminar, indicating that the applicant has attended a seminar related to electrical safety or compliance. This seminar, scheduled weekly by SURSECO II personnel, reinforces the importance of ongoing education and awareness in electrical safety and compliance.

Moreover, the result for interviews with electrical engineers, inspectors, and technical staff from the electric cooperative revealed key compliance requirements and common issues encountered during the building energization process. Their responses provided insights into the importance of adhering to SURSECO II's guidelines, ensuring electrical safety, and preventing delays in energization.

KEY COMPLIANCE REQUIREMENTS

Before a building can be energized, it must have complete permits and certifications, including zoning and building permits, an electrical permit, and a Certificate of Final Electrical Inspection (CFEI) from the local government.

The electrical installation must strictly follow Philippine Electrical Code (PEC) standards, particularly in terms of wire sizing, breaker ratings, conduit security, and grounding systems to ensure safety and efficiency. Electrical testing is mandatory, requiring buildings to pass insulation resistance tests, grounding evaluations, and load capacity assessments before energization approval is granted.

COMMON ISSUES ENCOUNTERED

Many buildings fail due to improper wire sizing, where undersized wires are used for circuits with high electrical loads, leading to overheating risks.

Some applications are delayed because of incomplete or incorrect documentation, requiring multiple revisions and follow-ups before approval. Improper grounding installations are frequently observed, increasing the risk of electrical faults and hazards. Certain applicants attempt to bypass the standard inspection procedures, but compliance checks ensure that only safe and well-installed systems receive energization.

The results confirm that strict adherence to SURSECO II's energization requirements is essential for ensuring safe and reliable electrical installations. The common issues identified, such as improper wire sizing and grounding deficiencies, align with previous studies (Bandara et al. 2024; Xing et al. 2022; Zainuddin et al. 2020) that emphasize the importance of electrical compliance. The requirement for proper documentation and testing serves as a preventive measure against electrical hazards (Ahern et al. 2023), highlighting the need for regular inspections and strict enforcement of standards to maintain electrical safety and efficiency.

CONCLUSION

This study aimed to assess the electrical wiring system of public infrastructure buildings in Surigao del Sur. Firstly, the research evaluated insulation resistance readings of various buildings using a Megger test. The results indicated that while most circuits in New Building 1, New Building 2, Old Building 1, and Old Building 2 demonstrated satisfactory insulation resistance, some areas required attention. New Building 1 showed a range from "Very Good" to "Fair," whereas New Building 2 generally performed well but had circuits with lower resistance readings. Old Building 1 had mostly good insulation but one circuit fell into the "Fair" category, while Old Building 2 showed strong insulation levels, although maintenance is needed for circuits with lower readings.

Secondly, the assessment of building wiring installations based on Philippine Electrical Code (PEC) standards revealed compliance issues. New Building 1 largely adhered to standards with appropriate wire sizes and breaker ratings, ensuring safe operation. However, New Building 2, Old Building 1, and Old Building 2 had circuits with undersized wires, incorrect breaker ratings, loose connections, and poor conduit security, posing risks of overheating and electrical failures. These issues emphasize the need for immediate corrective actions to enhance electrical safety.

Thirdly, interviews with SURSECO II personnel provided insights into building energization requirements. The process involves securing zoning permits, submitting detailed electrical plans, obtaining fire safety certifications, and fulfilling documentation requirements such as proof of seminar attendance. Compliance with these requirements ensures that buildings meet safety regulations before being energized, preventing hazards due to faulty installations. Additionally, common challenges identified include delays caused by incomplete documentation, improper wire sizing, and grounding deficiencies, further highlighting the importance of strict adherence to PEC and SURSECO II standards.

Based on these findings, it is recommended that public infrastructure buildings conduct detailed reviews and remediation of circuits with lower insulation resistance, implement routine insulation testing and maintenance, and upgrade wiring installations in New Building 2, Old Building 1, and Old Building 2 to comply with PEC standards. Undersized wires and incorrect breaker ratings should be addressed to prevent overheating and ensure system efficiency. Additionally, strict compliance with SURSECO II energization requirements should be maintained by regularly updating documentation, verifying permits, and conducting periodic reviews of the energization process to adapt to regulatory changes. Implementing these recommendations will enhance safety, reliability, and compliance in public infrastructure, ensuring a safer environment for all users.

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DECLARATION OF COMPETING INTEREST

None.

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