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Electrical System Studies as an Attempt to Prevent Installation in Historical Buildings

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Abstract:*The condition of installation system that is more than 50 years old is a problem related to standardization that refers to PUIL2000 let alone installation system in historical buildings that can pose a risk of failure of installation Which may cause fire. Thus the need for a thorough study of the standardization of systeminstallations in buildings especially historic buildings. This research is trying to examine how ideally the installation system is in a case study building on the historical building of the home of the history of the man Karno, using the termination method and analysis of this study resulted that; Electrical installations should be held regularly for inspection and testing by authorized agencies against misuse, malfunction or execution of unstandardized installations. The equipment selected to be installed in the electrical installation must meet the prevailing standards and comply with the provisions of PUIL 2000, and must match its use to its environment, and follow the instructions of the manufacturer of such equipment.*
Keywords*-Standardization, Electrical Installation, Historical Buildings*

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I. INTRODUCTION

The Government established the protection of historical heritage and cultural reserve in Law No 11 year 2010. Historical buildings are one of the sites that need to be kept sustainable. Sukarno's exile house located in the village of Laugumba Berastagi Tanah Karo Regency is one of the historical buildings that stood since the year 1719. The building's age has been more than 100 years old and has never undergone restoration, so it is vulnerable to damage, resulting in sustainability and continuity of the building. The condition also impacts the electrical instaltion security system in the building. Referring to the standardization of the Electricity Installation general rule (PUIL) that every 5 years the electrical installation system should be done maintenance, but the conditions that occur in the building of Sukarno's house of exile have not been done Treatment, especially in electrical installation systems. The condition of electrical installation system that has never experienced treatment will impact the safety so as to potentially the occurrence of fire risk due to failed installation.

Building condition that never get treatment affects damaged physical condition of the building, especially the condition of electrical installation system, according to officers who keep the building has never been doing maintenance or re-checking of the building's electrical system. According to the standard of general regulation of electrical installation, every 5 years the electrical installation system should be done maintenance, so it is very potential for the risks caused by the occurrence of failed installation. Based on the statistic event of fire in Indonesia the biggest cause of fire is caused by installation failure. Here is a graphic image that shows the cause of the fire started in 2012-2016 which indicates that the cause of the highest fire is a short-circuited electrical installation system caused by failure Installation.

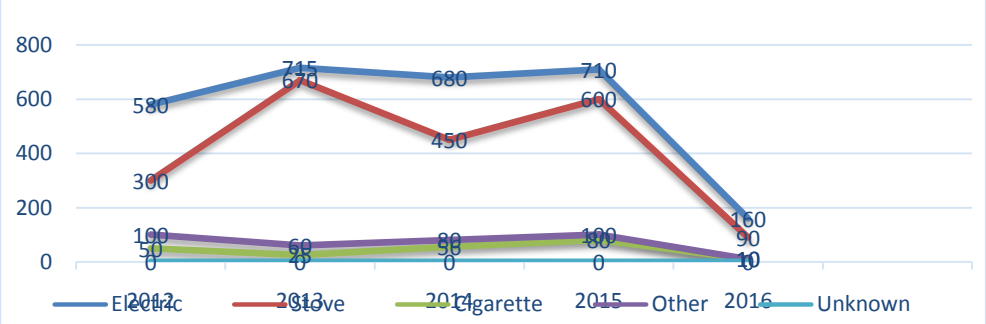

Figure 1. Fire statistics based on causes

The efforts undertaken by the Government and the community to protect historical heritage buildings one should be the center of attention is the electrical installation system, where most of the fires are caused by a short circuit of electrical installations. To suppress the occurrence of fire is by regular checking periodically and maintenance of electrical components.

Installation system checking is one of the very important efforts to avoid the occurrence of short-circuiting that will cause fires to be aged from the building has been very long. According to the officers who keep the building has never had any treatment or re-checking the electrical system of buildings, especially about isolation prisoners.

In PUIL required electrical installation system that has been aged over 5 years needs to be checked for its use. The condition of building history of the House of exile of a man who is currently over a hundred years old and has never done treatment, so can be made analysis of conclusions while that the electrical system and prisoners insulating the conductor cable on The building of the House of a. Karno exile in the village of Lau Gumba Berastagi should be done conservation, to prevent a brief hyphen that can cause fires in buildings caused by failure of electrical installations.

To prove the conclusion of the hypothesis necessary one test result is done through research examining the electrical system and testing isolation prisoners from the cable of the conductor to know it is still feasible or not to use. The subctance that became the problem in this research is analyzing and testing the electrical installation system of the historic building (the Exile House of Sukarno) in the village of Lau Gumba Berastagi, with the aim of producing for Know the standardization and feasibility of the electrical installation system in the history that corresponds to the standardization of electricity.

Figure 2 Electrical Panel conditions and the building of the House of Exile of Dude Karno in Laugumba village Berastagi

Figure 3 conditions of the building of the House of exile in Laugumba Berastagi village

II. Literaturereview

2.1. Electrical Installation Conductor

An installation conductor or electrical installation wiring is a medium to transmit the electric current or transfer the electric current. The material of this cable is variegated, specifically as an introduction to electric current, generally made of copper and is generally coated with a protective. In addition to copper, there are also cables made of fiber optics, called fiber optic cable.

The conductor or cable that is often used for electrical installation of lighting is generally made of copper. The half-hard copper conducer (BCC 1/2 H = Bare Copper Conductor Half Hard) has a type of prisoner 0.0185 ohm mm ²/M with a drop tensile voltage of less than 41 kg/mm ². While the conductiveness of the hard copper (BCCH = Bare Copper Conductor Hard), the tensile voltage strength is 41 kg/mm ². The use of copper as a conductor is to consider that copper is a material that has good send power after silver. The conductor made by the factory is a variety of plants.

Table 1. Nomenclature of cable codes in Indonesia

LETTER	DESCRIPTION
N	Standard cable with the conductor/copper core.
NA	Cable with aluminium as the conductor
Y	PVC Insulation
G	Rubber Insulation
A	Insulated Wire
Y	PVC sheath (polyvinyl chloride) for outer cable
M	PVC Sheath for Outer cable
R	Round steel wire (shield)
Gb	Steel pipe wire (shield)
B	Low pipe
I	For fixed isolation beyond the reach of hands
re	Rounded solid Conductor
rm	Wire-round conducted
Se	Solid-form Conduccals
Sm	The chosen conductor of the sector
f	Smooth conductor Round
ff	The conductor is very flexible
Z	Conductor-Z
D	The 3-lane conductor is in the center as a protector.

2.2. Installation Safety

Installation safety is necessary because it is useful to keep damage to electrical installations caused by short dashes and more loads. The usual installation guard used in residential installations is the Mini Circuit Breaker (MCB), which can disconnect the current on a circuit in case of short-circuiting and detecting more loads. If installation safety is not installed in an electrical installation, in case of short-circuited interference, it can cause fire hazard. Therefore, installation safety is very important for residential electrical installations. (Indra Z, 2011).

2.3 Grounding

The ground system is one of the general conditions of electrical installation. The installation is to use the earth electrodes that are planted directly into the soil. The Earth's electrode is an inflow planted in the soil that flows directly into the ground. Ground is a protection tool to secure and minimize the risk of power users in the danger of touch voltage. What is meant by touch voltage is that the voltage can be touched, which arises during isolation interference between two parts simultaneously. If in a network system has been installed and there is damage to isolation, the danger of touch voltage for power users can be avoided, because the ground system drain the current to the ground through the earth electrodes. Each type of soil has its own resistance value.

The ground also serves as a protection on household electrical appliances used by consumers in fulfilling their household needs that prevent the damage caused by leaking stress. (PUIL 2000).

2.4 Electrical Installation Standardization

The level of quality of human resources is influenced by the level of education, which illustrates the behavior of one's daily life in the community in response to the increasingly sophisticated technology, especially

in the field Existing electricity. The installation policy of a residential installation is tied to the prevailing regulations in Indonesia, namely the general requirements of Electricity installation (PUIL) and other supporting regulations. Installation of residential installations carried out by the instalature who have held license from PLN as BTL (Electrical Engineering Bureau) should implement the planning and conduct the overall trial of installation before the customer is given an electrical connection by PLN. PT PLN (the state electrical company Persero) acts as the supervisor of implementing PUIL regulations as well as a residential installation controller conducted by the BTL (Electrical Engineering Bureau). (PUIL 2000).

Electricity needs are the main needs in addition to boards, clothing and food that makes life better. Electrical functions in households other than as lighting is also beneficial for cooking, electrical appliances, cleaning equipment, driving force and others. Electricity in household life on one side has many benefits but on the other hand has a huge risk that can be harmful to the wearer. If it is wrong in its handling and use so it will be fatal to the human life. (Ahmad Yufron 2016) It does not mean that electricity is very feared to be avoided but the most important thing is how we can wear and utilize electricity properly and safely so as not to harm ourselves, others or the environment.. Installation and addition of electrical installation by using equipment that is not based on the knowledge of electrical installation can be dangerous moreover not carried out the maintenance of a comprehensive electrical equipment.

The dangers caused by electricity include fires that can harm human beings (users), other people and the environment and danger of short-circuited and electric shock that can result in death. Based on the above explanation on the level of basic knowledge about the electrical installation of residential houses in Kampung Six affect the use and utilization of electricity so that the dangers that can be inflicted by electricity can be prevented and Anticipation in the installation of electrical installations with the correct knowledge of the electricity installation of the living House accordingly. (PUIL 2000).

III. METHODOLOGY

Research conducted in the year with the main purpose of research in the form of security system review of electrical installation system in historical buildings. In the first year the study focused on observing and measuring the conditions of the electrical installation system found in the historic building of Sukarno's exile house. In the second year of research focused on testing and comparison between the test results with the electrical standard referring to Puil, then will be designed design of the installations system in accordance with the standards that will be used as reference Related Parties for maintenance and conservation. For smooth implementation and can obtain good data need to be done research phase of the system by doing the following:

1. Library Research, which is collecting data that has to do with the writing of the thesis by reading the material and text books standard, e-book, internet, related journals, and scientific works.
2. Observation method (observation), which is observing directly to the object that has been selected.

Analysis method.

IV. RESULT AND DISCUSSION

4.1 Research Results

From the results of the research according to the standardization contained in the general rules of Electricity Isntalasi (PUIL) is known that the use of the right cable can reduce the risk of fire and short-circuited disruption that is influenced by the internal factors in Installation system.

4.2 Measurement Results

Based on the measurement results obtained the following data:

Table 4.1 Measurement Results

No	Measured parameters	Standar PUIL	Existing condition	Standar Bats	Results
1	Input voltage	220 V	215 V	5%	Standard
2	Drop Voltage	5%	2,5%	5%	Standard

4.3 Discussion

Electrical installation is the connection or the relationship of electrical equipment to other electrical equipment that must meet the standards set by PUIL in 2000.

The electrical wiring Connection system is a way of terminating the equipment to be used in the installation. In connection with the things to be considered, among others, is: the durability of the connection

that is free of mechanical and electrical tensile style and chemical materials, as well as the type of terminal connection, and the placement of equipment in the usage according to its usefulness.

The cable connection is warpage with Lasdop. Installation connections must not be carried out in the pipeline, should be carried out in the connecting box, as well as to electrical equipment, should be designed so that in normal working conditions do not harm or damage, well installed and resistant to mechanical, thermal, and chemical damage. A cable connection with duct tape Displays the media connection of the twisting cord, where the connecting box as a means for the connection of the cable in the electrical installation, using plastic insulation as the cover of the connection to avoid the occurrence of electrical short connection. This method is very often done in the installation of electrical installations, especially in cable connection, it needs to be calculated the number of connections in the connection box.

Cable connection with terminal. An electrical installation cable connection using a terminal system is a very secure form of connection. The durability gained by the terminal connection system is quite high, has reliability in the tensile style, and is spared from shock, thereby avoiding a short connection. Cable connection with cable boots. Cable boots are used to connect the NYAF fibre cord. The use of cable shoes in the connection system should be done, because if not done the core of the wires will be easy to scatter and contact, and the connection will not be sturdy against the bolt or terminal tool. If the cable used in the connection system is the cable or NYM, and at the end of the cable that will be connected is not given cable shoes, then the end of the cable must be made form Ayelet (eye duck). Pipe filling factor in cable connection. The wire fill factor in the pipeline and the cable connection inside the connecting box, greatly affects the system's reliability and security from the electrical installation. The installation does not meet the default against pairing of the connection in the Connect box, if it exceeds the pipe fill factor or the Connect box that has been set. The default is missed by the example of using the amount of cable charging factor in the pipeline or in the Connect box.

Examples: Cables used in the home electrical installation channels, diameter of 2.5 mm and if insulated with a diameter of 3.9 mm, the filling factor of the pipe used if more than 3 cables are filled to the diameter of the pipe is 35%, and the diameter of PVC pipe used in the installation is 5/8 inch (15.875 mm), then the number of cables that can be filled against the PVC pipe is 5.8 (rounded into 6 diameter of 3.9 mm) Select the cable size according to the manual or PUIL. Then it is selected KHA cable and KHA gadget protection (MCB or fuse) appropriate, namely by using (for ITS cables) and (for the cable NYM) suitable in the book PUIL.

a. Installation requirements

All conductors used in the installation must be made of materials that meet the requirements of standardization, according to the purpose of its use, and already tested and in check according to the standards of the conductor issued or recognized by the agencies The general regulation of the installation of electricity (Puil 2000) are:

Section size: The area of the conductor's cross section should not be smaller than the standard set.

Table 4.2 Cable Section Minimum Area

1		2	3	
Types of wiring Systems		Use of circuits	Conductor	
			Materials	Sectional Area mm^2
Installation (fixed-mounted)	Insulated cables and Conduct intercompany	Power and Lighting circuits	Copper Alumunium	1,5 2,5
		Signal and Control circuits	Copper	0,5
	Naked Conductors	Power circuits	Copper Alumunium	10 16
		Signal and Control circuits	Copper	4
Flexible connection with isolated and wired Conduct		For special devices	Copper	Compliant with IEC
		For any other implementation		0,75
		Extra low voltage circuits with special devices		0,75

From the table above, it can be seen that each type of wiring system can be seen by the wiring system of each table where for each type of standardization, depending on the material that the conductor used. The table is a standard that is set by the general rules of electricity installation book. Conductor Color identification: Required with the aim of facilitating the installation and maintenance so as not to be confused between one cable and the other. (PUIL 2000)

4.3 Table Core or Color Rail Conductor

Core or rail	Identifier		
	By letter	By emblem	By Colour
1	2	3	4
A. Alternating current installation Phase One Phase Two Phase Three Neutral	 L1/R L2/S L3/T N		 Red Yellow Black Blue
B. Electrical equipment Installation Phase One Phase Two Phase Three	 U/X V/Y W/Z		 Red Yellow Black
C. Direct current Installation Positive Negative Middle Wire	 L+ L- M	 + -	 Not defined Not defined Blue
D. Neutral conductor	N		Blue
E. The earth conductor	PE		Striped, green, yellow

In table 4.3 describes the identification of wire or conductor cables aimed at determining the type of cable and loading at the time of installation and at the time of maintenance, according to the table 4.3 there are several types of conductor color: red, Yellow, black, blue, green and cross, so it can be easily known the installation of conductor materials on Fhasa, one, two, three and neutral and also for the type of conductors for the ground or grounding existence.

Table 4.4 Colors Outer Casing PVC Cable

Cable type	Nominal Voltage	Outer casing Color
PVC sheathed cables for fixed installation (Missal NYM) PVC sheathed air barrier (e.g. NYMI) PVC sheathed Cables PVC sheathed Cable	500 V 500 V 0,6/1kV Above 1 kV	White Black Black Red

Cable insulation Prisoner: This is a basic protection on low voltage electrical installations because it is very influential in the quality and feasibility of an installation.

Table 4.5 Minimum Isolation Resistance Value

V Nominal circuit voltage	V Direct current Test voltage	Isolation resistance (Mega Ohm)
Extra-Low voltage (SELV, PELV, and FELV) that meet the requirements of 3.3.1 and 3.3.2	250	≥ 0,25
Up to 500 V, with the exception of the above	500	≥ 0,5
Above 500 V	1000	≥ 1,0

In the table 4.4 describes the magnitude of the isolation resistance value on the allowed conductor cable and corresponds to the standard suppose on some types of the following wiring cables:
Cable NYA 4 re 1000V
States a wire insulated for a nominal voltage of 1000V, PVC insulated and has a solid round copper conductor with a nominal cross area of 4 mm ².
Cable NYM – 0 4 x 2,5 rm 500V
It states a large-core cable for a nominal voltage of 500 V, insulated and sheathed with PVC and has a round wire conductor with a nominal cross section of 2.5 mm², with a green-yellow vein colour identifier system.

a. Conductor section area selection

The wide selection of cross section of the conductor should consider the following:
According to PUIL 2000 article 5.5.3.1 that having an "end circuit conductor that supplies a single motor should not be a KHA less than 125% of the full load identifier current."

1. For direct current: In = P/V (A)
2. For alternating current one phase: In = P/(V. Cos φ) (A)
3. For alternating current three phases: In = P/(.V. Cos φ) (A)

KHA = 125% X In
Which:
I = Full load Nominal Current (A)
P = Power on (W)

P = Power on (W)
V = Voltage (V)
Cos φ = Power Factor

a. DropVoltage

Drop voltage or called by voltage shrinkage is the difference between the source voltage with the voltage in the load, because the voltage in the load is not equal to the source voltage ie the voltage at the load is less than the source voltage, can be caused by factors Flow and impedance of channels.

b. Environmental properties

The nature of the environment is the condition in which the conductor is installed.
The following factors should be observed:

- The conductor can be installed or planted in soil with regard to soil conditions that are wet, dry or humid. This will relate to the consideration of the conductor insulation materials used.
- Ambient temperature such as room temperature and high temperature, the conductor used will be different.
- Mechanical strength, for example: the installation of a highway conductor is different from indoors or residences. The conductor is subjected to load.

c. Other possibilities

The other possibilities are the possibilities that will happen in the future. Like the addition of loads that will refer to the increase in the load current so that the calculation of the inhibitor KHA to select the area of the inter-section of the conductor will differ. The maximum allowed Drop voltage is two percent for illumination and five percent for power installation.

V. CONCLUSION

From the research results on the impact of loss, when the installation of electrical houses and buildings is not standard, then:

1. Real fire arising from gross negligence and electricity consumption, which can result in substantial damage to the material and can also result in loss of life, especially in historic buildings.
2. One of the abuse in the utilization of typical electrical installations is an improper use of electrical installation, and is a common problem among power users in Indonesia
3. Electrical installation shall be held regularly examination and testing by the competent authorities against misuse, malfunction or execution of unstandardized installations.
4. The equipment selected to be installed in the electrical installation must meet the prevailing standards and obey the provisions of PUIL 2000, and must match its use of the environment, and follow the instructions of the manufacturer of such equipment.

The vitality and strategic power of the function and role of electricity, for those who provide and use it, the availability must meet the basic reliable, safe and familiar environment.

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