

Analysis of Individual Knowledge of Lightning Protection

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Abstract— The phenomenon of lightning is one of the main threats that can damage buildings and cause material losses and loss of human life. Residential houses are one type of building that is vulnerable to the impact of lightning. Therefore, designing an effective and efficient lightning rod is very important to protect residential houses and their occupants. This research aims to analyze individual knowledge related to lightning rods by looking at existing literature reviews, as well as providing information about the types of lightning rods that exist and how to use them. Later this research can make it easier to design a lightning rod system that is suitable for residential houses by considering the safety and comfort of the occupants. In this research, we conducted a survey and analysis of scientific articles, books, and other reliable sources relevant to individual knowledge about lightning rods. This research will include an understanding of the working principle of lightning, risk assessment of residential houses, selection of the right type of lightning rod, and selection of suitable materials for lightning rod systems. The research method used is interviews with residential homeowners. This interview was conducted to obtain information regarding their experience and knowledge about lightning rods. Based on the results of interviews with residential homeowners who do not install lightning rods, it can be concluded that an effective lightning rod must consider factors such as the specific needs of the residence, environmental characteristics, and local weather conditions. The selection of the right type of lightning rod, and the use of high-quality materials are key factors in designing an efficient lightning rod system. This research can serve as a guide for residential homeowners who want to protect their property and occupants from lightning hazards by installing a proper lightning rod system.

Keyword: lightning rod, individual knowledge level, awareness, lightning rod installation

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I. INTRODUCTION

Lightning is a natural phenomenon that can pose serious hazards, including damage to buildings and electronic equipment, fire, and even injury or death. To protect oneself and property from the impact of lightning, lightning rods are used as an effective solution. Lightning rods are systems specifically designed to divert and safely channel lightning currents to the ground (Anderson et al., 2022; Dagar et al., 2021; Kilis et al., 2023; Saragih et al., 2020; Vegunta et al., 2021).

Nowadays, it is still common to hear of people dying from being struck by lightning, whether they are children, young people or adults. In Indonesia itself, this kind of incident is very often heard. As happened in Depok, as reported by Serambinews.com on January 17, 2022, a child died as a result of being struck by lightning. That afternoon the weather was cloudy and drizzling. Inside the house, the boy was watching television with other family members.

Suddenly lightning struck the television antenna and entered the house.

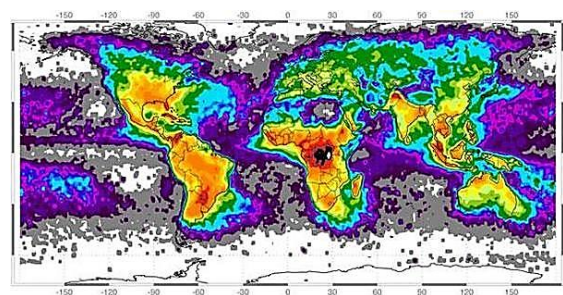


Figure 1. Lightning distribution map in the world (www.newscientist.com)

The picture above is a Lightning Distribution Map in the World, the black area in Central Africa is where the highest intensity lightning occurs in the world, the red, orange and yellow areas are areas with high lightning intensity, while the white or blue areas are areas with low intensity.

Lightning is a natural event, namely the process of electrical discharge that occurs in the



atmosphere. This discharge event will occur due to the formation of a concentration of positive and negative charges in the cloud or the difference in charge with the earth's surface. Lightning actually occurs more often between one charge and another charge in the cloud compared to that which occurs between the center of charge in the cloud and the earth's surface. Both types of discharge can actually cause interference or loss. Lightning that occurs between clouds and clouds can interfere in the field of aviation, while lightning that occurs between clouds and the surface of the earth can cause damage to tall buildings and equipment (NASAR & TRUTT, 2018; Wibowo, 2018). The building security system is made to protect the building from various kinds of disturbances. One of the building safety systems is a lightning rod system along with grounding or earthing. The damage that can occur to buildings as a result of lightning strikes is mainly the amplitude of the lightning current and the steepness of the lightning current where the lightning amplitude ranges from 5-200 KA. Because damage to buildings that are struck by lightning usually results in fires that will also endanger surrounding buildings or buildings, in tropical areas with many hurricanes accompanied by lightning, lightning rods should be used. If a metal rod is installed on top of a building with a tip that can conduct electric current perfectly to the ground and is well grounded, then the building is fully protected against lightning strikes as stated by B. Franklin (Fauzi et al., 2021; Harmoko & Lestari, 2022).

Lightning rods are a critical component in lightning protection systems that aim to protect buildings, infrastructure, and people from the dangers of lightning strikes. The dangers posed by lightning include structural damage, fire, and even injury or loss of life. Therefore, a good understanding of lightning rods is essential for individuals and the general public (Hasibuan et al., 2021).

Although lightning rods are a critical component in protection against lightning, individuals' knowledge of lightning rods is still an often overlooked issue. Many people do not fully understand the working principles, functions, and benefits of lightning rods. When individuals do not have adequate knowledge about lightning rods, they may not realize the risks faced during a thunderstorm. They may not understand the need to protect their buildings with appropriate lightning rods, or may even overlook the importance of regular maintenance on existing lightning protection systems. As a result, the use and maintenance of lightning rods can be ineffective or even completely neglected (Fernando Yalindua et al., 2022; Karta et al., 2020).

In addition, common myths and misconceptions about lightning rods can also affect

an individual's knowledge. Some people may believe the myth that tall buildings or trees around them are enough to protect them from lightning strikes. As a result, a lack of awareness about lightning rods and a misunderstanding of their function can have a negative impact on public safety and protection. Improving individuals' knowledge of lightning rods is key to raising awareness and reducing risks to lightning hazards (Budiman, n.d.; Priyono & Pramodita, 2020).

It is important to understand an individual's level of knowledge about lightning rods, as insufficient knowledge can lead to unnecessary risks. Good awareness and knowledge of lightning rods can help people to take appropriate action in protecting themselves and their assets from lightning hazards. Therefore, it is necessary to conduct a comprehensive analysis of individuals' knowledge of lightning rods to identify gaps in their understanding and the factors that influence it (Lubis et al., 2019).

Previous research on individual knowledge of lightning rods is still limited. Therefore, this research aims to conduct an in-depth analysis of individual knowledge regarding lightning rods. By gaining a better understanding of people's knowledge level, we can identify existing knowledge gaps and design effective educational strategies to increase awareness and knowledge regarding lightning rods (Sampeallo et al., 2020).

In this research, we will use the survey method to collect data on individuals' knowledge of lightning rods by considering factors such as education, age, occupation, and previous experience with lightning rods. The survey will include questions involving important aspects such as the working principle of lightning rods, the types and components involved, routine maintenance, and the beliefs and behaviors of using lightning rods.

The results of this study are expected to provide valuable insights for lightning rod system designers, service providers, and relevant authorities. By understanding the knowledge level of individuals, more effective approaches can be developed in providing education about lightning rods and can be used to design more effective educational programs and extension campaigns to increase awareness and protection against lightning hazards. This is expected to increase public awareness and understanding of lightning rods, and encourage better use and maintenance to protect themselves and their property from lightning hazards.

By conducting an in-depth analysis of individuals' knowledge of lightning rods, we can advance measures to mitigate lightning risks and ensure better safety for society as a whole.

1. Definition of Lightning Rod

A lightning rod is a system designed to protect buildings, equipment and people from the dangers posed by lightning. The main purpose of a lightning rod is to safely conduct lightning current to the ground, thereby reducing the risk of structural damage, fire, and danger to human life (Wahyuni Dali et al., 2022).

There are several main components in a lightning rod system (Suryadi et al., 2022):

- **Lightning arresting conductors:** Lightning arresting conductors consist of copper or aluminum wires installed on top of buildings. These conductors collect the electrical charge from lightning and direct it downwards.
- **Lightning catcher poles:** Lightning catcher poles are installed at the highest part of the building and serve as the starting point for attracting lightning. Lightning catcher poles are usually made of materials that are resistant to corrosion and have an optimal shape for attracting lightning.
- **Lightning conductor:** Lightning conductors are copper or aluminum wires that connect the lightning catcher pole with the ground delivery system. These conductors must be installed properly and through a safe path to prevent structural damage and fire.
- **Lightning delivery system:** The lightning conducting system consists of a network of copper or aluminum cables that direct lightning current to the ground. This includes the main conducting cable connected to the lightning conductor and the ground conducting electrodes installed in the ground.
- **Ground conducting electrodes:** Ground conducting electrodes are part of the lightning conducting system that serves to safely conduct lightning currents to the ground. These electrodes are usually copper rods or copper sheets connected to the building grounding system.
- **Grounding system:** A grounding system is a system that provides a conductive path for lightning currents to flow into the ground. It involves the use of grounding electrodes and proper grounding connectors to ensure lightning currents are properly and safely directed.

2. Conventional Lightning Rod

This lightning rod is a simple device that usually only waits for lightning to strike the tip of the rod. The working principle of this lightning rod is to capture lightning passively. It looks like a pole and

requires a conductor cable. Because it is passive, buildings with large areas often use several rods at once at the top of the roof. This rod can also be installed anywhere but is more ideal for buildings with a narrow area, such as residential houses (Seniari, 2021).

This method was developed by Benjamin Franklin (1750) by creating an electric current channeling system that connects the top of the building with a grounding system.

The tip of a conventional lightning rod is pointed like a spear and made of rust-resistant metal (copper, aluminum, stainless steel, brass) and lined up in parallel / single on top of the building. The protection radius of a conventional lightning rod is 45 degrees.

This technique was first recognized using the first principle, namely by forming a kind of shield or shield in the form of a conductor that will take over lightning strikes. This kind of lightning rod is usually called groundwires in the air transmission network, while in buildings and protection of structures, Benjamin Franklin called it the lightning rod. In the UK and several countries in Europe use the term lightning conductor while in Russia it is called lightning mast (BIANTORO et al., 2020).

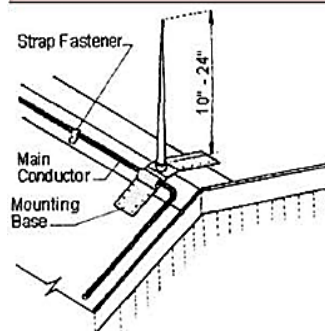


Figure 2. Conventional lightning rod

3. Electrostatic Lightning Rod

Electrostatic lightning rods are a development of conventional lightning rods (lightning conductor). The principle is the same, namely as a shield or shield that takes over lightning strikes (Ermawati & Harda Arya, 2021). The difference lies in how to divert the lightning strike (Ginting et al., 2020). There are 3 important principles that electrostatic lightning rods have (Naibaho & Sofiyani, 2021):

- 1) Distribution of currents that are very tight or closed from the surrounding by using receiving terminals and special conductor cables that are highly insulating.
- 2) Creating a large initial free electron as a streamer emission at the peak.
- 3) This lightning rod system is divided into 2, namely the EF Terminal which is placed at the

top of the building as a lightning rod and the EF Carrier (conductor cable) which goes into the ground. Combination of electrostatic terminal and electrostatic carrier which has high voltage insulation lightning rod.

The principle of the electrostatic lightning rod is based on the ions generated by the two electrodes at the end of the lightning rod. Under the influence of the electric field between the cloud and the earth, there will be a potential difference between the two electrodes. This voltage between the two electrodes can cause an electric spark that makes the air molecules around the two electrodes ionize, thus accelerating the process of forming an upward streamer from the lightning rod. The earlier process of upward streamer formation causes the upward streamer formed to be higher than the usual conditions in conventional lightning rods. Therefore, the electrostatic lightning rod seems to have a higher effective protection height than the actual lightning rod (Purwanti et al., 2018).

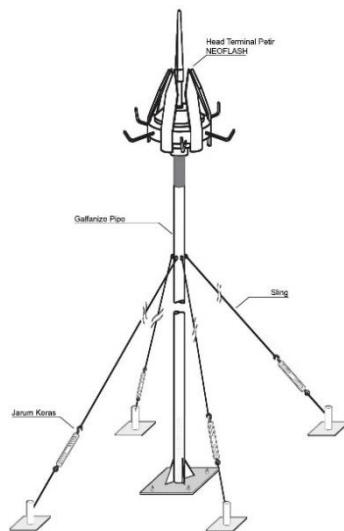


Figure 3. Electrostatic lightning rod

4. Catenary Wire Lightning Rod

A catenary wire lightning rod, also known as a wire network lightning rod or network wire lightning rod, is a type of lightning rod that uses a network of wires installed above the building structure or area to be protected (Pulungan et al., 2022; SUYANTO et al., 2019).

The working principle of the catenary wire lightning rod is to create a wire network that runs over the area to be protected. This wire network is usually made of stainless steel or aluminum alloy that is resistant to corrosion. In some cases, the catenary wire can also be made of other conductive materials (Arifin, 2021; Duanaputri et al., 2021).

The catenary wire is installed at the right height above the roof or structure, and visually forms a network that hangs like a rope or wire. This network creates a conductive path that directs lightning strikes towards the ground in a controlled manner. When a lightning strike occurs, the catenary wire will capture the electrical energy from the strike and conduct it through the wire path to a ground-connected conduit system (Gemilang et al., n.d.; Noviana & Karim, 2022).

5. Lightning Rod Instalation

There are several ways to install a lightning rod, such as an example of installing a conventional lightning rod. Compared to the electrostatic type, the conventional type is relatively easy to install and can even be done by yourself (MAHENDRA, 2022; Muhammad Priyo, 2022). The following are the installation steps:

- Prepare the grounding system first, by looking at the layout of the soil structure. Plant the ground rod to the depth of groundwater so that lightning can be channeled into the ground.
- Make a lightning path connection with a conductor cable that connects between grounding and avoid installing notched cables or forming pointed angles so that there is no jumping of electric charges during lightning.
- Determine the position of the splitzen in the highest part of the building, namely the roof.
- Make sure the entire device network is properly installed.

The selection of the right type of lightning rod must consider various factors, such as building type, size, geographical location, and applicable regulations. Consult a lightning protection expert or related professional to ensure the selection of a lightning rod that suits your needs and character (Medika & Widagdo, 2023).

II. METHOD

In this study, qualitative research methods were used with the aim of finding information and to educate about this research. Qualitative research method is an approach used to understand and explore in-depth understanding of complex and contextual phenomena. The method used in this qualitative research is the interview method. Interviews were conducted with several students of the Indonesian Education University and several residents located on Jl. Kiaracandong Bandung. The steps in conducting qualitative research methods by means of the interview method include (Figure 4):

Analysis of Individual Knowledge of Lightning Protection

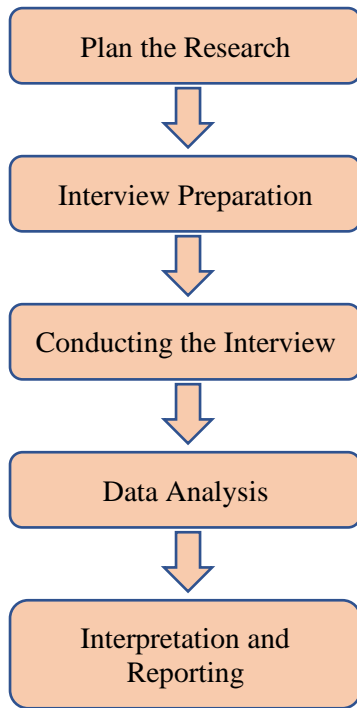


Figure 4. Qualitative Research Steps

In this case, interviews were conducted with people who were still unfamiliar with the material of this research. And the interview was conducted by asking several questions with the same questions to each person.

The interview used was an In-depth Interview. These interviews are conducted one-on-one with respondents and focus on a deeper understanding of their experiences, attitudes or views. In-depth interviews were used in this research to better understand individuals' points of view.

III. RESULTS & DISCUSSION

In this discussion we conducted several interviews with several residents and several students to find out how much people know about lightning rods. The purpose of this interview is to find out how much people know about lightning rods and to educate people so that they understand how important lightning rods are. The questions used were the same questions we asked the people. And most people answered with the same questions

The following are the results of our interviews with several people who are unfamiliar with lightning rods (Table 1):

Table 1. Interviews with several people who are unfamiliar with lightning

Questions	Answer
what do you know about lightning rods?	Lightning rod is a tool to protect the house from the danger of lightning and to

	protect electrical equipment from damage.
Do you have a lightning rod installed in your home? If not, why?	No, because the weather in Indonesia does not always experience lightning rain, so we need other items that are more useful than lightning rods.
So is a lightning rod important or not?	Very important but there are more important and more useful things to use.
If your house was struck by lightning, would you install a lightning rod?	I wouldn't install it anyway, because it's not often that lightning strikes and it's also very difficult for lightning to strike here.
Do you know what buildings are suitable for installing lightning rods?	Maybe like tall buildings like companies and others. And also, buildings whose areas are very prone to lightning rain

The following are the results of our interviews with several people who understand lightning rods (Table 2):

Table 2. Interviews with several people who understand lightning rods

Questions	Answer
what do you know about lightning rods?	A lightning rod is a protection system designed to protect buildings and occupants from the dangers posed by lightning.
Do you have a lightning rod installed in your home? If not, why?	Of course, because the weather in Indonesia is very difficult to guess, we will not know when there will be lightning rain and I put up to take care if there will suddenly be lightning rain. at least I feel safe if there will be lightning rain.
So is a lightning rod important or not?	Very important, because we cannot take lightning lightly. Buildings that are hit by lightning can cause damage, fire or hit someone in the building.
Is it important for citizens to know about it?	It is very important for citizens to know about



	lightning rods because lightning can cause serious damage, fire, and even jeopardize life safety. Knowledge of lightning rods helps us protect ourselves and our property.
Do you know what buildings are suitable for installing lightning rods?	Ideally, all buildings located in areas prone to lightning should be equipped with lightning rods. Although there is no full guarantee, lightning rods can reduce the risk of damage and fire caused by lightning. In addition, there are regulations and requirements that require some types of buildings such as hospitals, schools, and shopping centers to have lightning rods.
How to obtain a lightning rod and are there any costs associated with its installation?	To get a lightning rod, it is advisable to contact a trusted lightning rod service provider. They will conduct an assessment and design a lightning rod system that suits the needs of the building. Of course, installing a lightning rod will cost money. The cost may vary depending on factors such as the size of the building, the complexity of the system, and the geographical location.
What can citizens do to raise awareness about the importance of lightning rods?	Citizens can raise awareness about the importance of lightning rods by sharing information with their neighbors, family, and friends.

buildings is very important, especially in tall buildings.

Indeed, for needs there are times when we choose other items that are more needed, but what is wrong with installing a lightning rod for a house building. Even though the cost for lightning rods for home buildings is very affordable.

Lightning rods are also very much needed because lightning is not something that can be taken lightly. Lightning can make buildings catch fire, lightning can make electrical equipment damaged and lightning can also endanger people.

IV. CONCLUSION

A lightning rod is a system designed to protect buildings, equipment and people from the dangers posed by lightning. The main purpose of a lightning rod is to safely conduct lightning current to the ground, thereby reducing the risk of structural damage, fire, and danger to human life.

Lightning rods also have several types such as, Conventional Lightning rod, Electrostatic Lightning rod, etc.

Based on the results of the interviews above, it can be concluded that lightning rods are very important for the safety of ourselves and the electronic items we have, because lightning strikes can cause damage, fires and also fatalities. However, not everyone considers lightning rods very important to use in building a house, there are also people who consider lightning rods only important to use in places where their homes are very vulnerable to lightning.

They consider that with Indonesian weather that is unpredictable when lightning comes, it is better to buy other items that are more needed. Whereas with Indonesia's unpredictable weather, lightning rods are very much needed because we will not know when lightning will occur. So to minimize damage to the house, you should install a lightning rod on the house.

It is important to contact professionals who are experienced in designing, installing and maintaining lightning protection systems. They will be able to evaluate the specific needs of your building and ensure that the lightning protection system functions properly and meets the relevant safety standards.

Awareness about the importance of lightning rods can be increased by sharing information with neighbors, family, and friends, and educating them about the benefits and importance of lightning rods.

There are some people who still don't understand lightning rods and some who are very familiar with lightning rods. As in the example above, there are still people who consider the lack of importance of lightning rods.

Even though lightning rods are very important to use by seeing that Indonesia has extreme and unpredictable weather, using lightning rods in

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