

# Review Of Protection Of Building From Lightning Strokes And Its Different Methods

Seema P. Navghare<sup>1</sup>, Bhoopesh N. Chaudhari<sup>2</sup>

<sup>1</sup>Student M.E. (Electrical Power System),

P.E.S College of Engineering, Aurangabad, Maharashtra, India

<sup>2</sup>Associate Professor (Electrical Engg. Department),

P.E.S College of Engineering, Aurangabad, Maharashtra, India

## ABSTRACT

This research paper covers the topics related to the protection of building from lightning strokes using various methods. This paper focuses mainly on the methods of lightning protection system to protect buildings from any losses occurring due to lightning strokes including the human life and all the electrical devices installed in the buildings. This paper also covers the various details regarding the protection of building from lightning strokes.

**Keywords:** Protection of building from lightning strokes, standards for lightning protection system, franklin rod method, franklin/faraday cage method, early streamer emission method.

## 1. INTRODUCTION

Lightning strokes discharges high voltage electricity towards the earth which can cause damage to the buildings, electrical appliances resulting in fire hazards and ultimately resulting in loss of life. Hence there is a need for protection against lightning strokes by installing a suitable lightning protection system. The lightning protection system provides a separate path of low resistance for discharge of lightning strokes towards the ground. The basic components involved in the lightning protection system are lightning rods, conductor cables and ground rods which provides the separate path for the discharge of lightning. The simple operation of the lightning protection system functions when the lightning strikes the building, the lightning rod placed on the building captures the lightning stroke and is discharged through the conductor cables placed on the roof and other parts of the building to the ground rods placed inside the earth. Hence the lightning protection system is used for safeguarding the building and its surrounding areas [1]. There are various methods used in lightning protection system and the most popular are the Franklin rod method, Franklin / Faraday cage method and the Early streamer emission method [2]. Many national and international standards like NFPA 780 provides lightning protection system installation requirements to avoid any damages to buildings, electrical components and installations, fire hazards and ultimately human life occupying the building [3].

## 2. REVIEW OF STANDARDS FOR LIGHTNING PROTECTION SYSTEM

The standards for lightning protection systems are the National Electrical Code (NEC), Lightning Protection Code (NFPA 780) and Standard for Installation Requirements for Lightning Protection Systems (UL 96A). A brief reference for the basic components used in the lightning protection system obtained from the standards is mentioned in the tables 1 & 2 [4] [5].

### I. Standard for Class I material

Table 1: Class I material – less than 75 feet [4] [5]

Component	Item	Copper	Aluminum
Solid air terminal	Min. Diameter	9.5 mm	12.7 mm
	Min. Diameter	15.9 mm	15.9 mm
Tubular air terminal	Wall thickness	0.8 mm	1.6 mm
	Min. strand size	17 AWG	14 AWG
Main conductor cable	Cross section	29 mm <sup>2</sup>	50 mm <sup>2</sup>
	Thickness	16 AWG	14 AWG
Main conductor solid strip	Width	25.4 mm	25.4 mm

### II. Standard for Class II material

Table 2: Class II material – greater than 75 feet [4] [5]

Component	Item	Copper	Aluminum
Solid air terminal	Min. Diameter	12.7 mm	15.9 mm
Main conductor cable	Min. strand size	15 AWG	13 AWG
	Cross	68 mm <sup>2</sup>	97 mm <sup>2</sup>

	section			
--	---------	--	--	--

### 3.METHODS OF LIGHTNING PROTECTION SYSTEM

#### 3.1. Franklin Rod Method

The following figure.1 shows the lightning protection system using Franklin rod method.

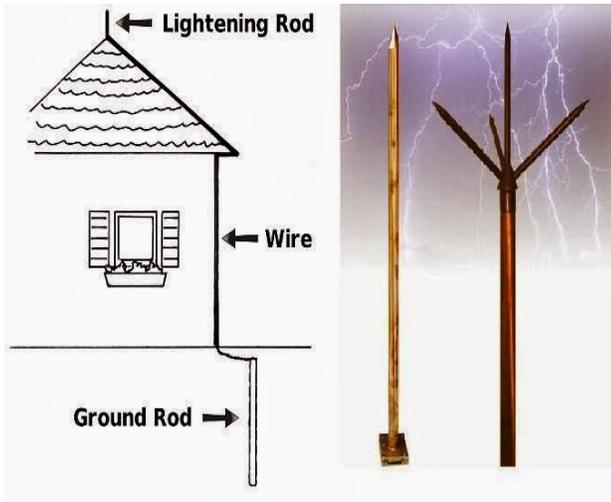


Fig.1 Franklin rod method

Franklin rod method consists of a pointed rod which attracts the lightning stroke and passes it through the conductor cables to the ground [6].

The length of rod has a standard size of 2 or 4 metres and can be extended upto 7 to 8 metres by adding elevation rods. The material used for elevation rods is made up of stainless steel or treated steel [9]. The lightning rod provides a cone shaped range of protection with an angle of  $45^{\circ}$  at the tip of the rod. The protection range forms a circular base around the building to be protected. This method is used for buildings having a height of 20 m or below. Hence by using the franklin rod method at critical areas we can reduce the damages caused by lightning significantly [2]. The advantage of this method is that the method is economical, installation is easy and can be easily installed with the existing building structure. The disadvantage with this method is that it is limited to protect small size structures and mechanical withstand constraint is less [8].

#### 3.2. Franklin / Faraday Cage Method



Fig 2. Faraday cage method

A faraday cage method consists of a cage-like set up using conductor cables and laid on the building in a grid like pattern. The lightning when strikes the lightning rod passes the electric charge to the ground through the grid pattern of conductor cables which acts as a cage to the building and protects the building from any damages. This method is the most reliable type of lightning protection system [2]. The advantage with this method is the reduction of electromagnetic radiation effects with the structure to be protected, the lightning currents are passed through all the meshed down conductors. The disadvantages are that the method is complex to install due to the mesh or cage type conductors and it is very costly [8].

#### 3.3. Early Streamer Emission Method

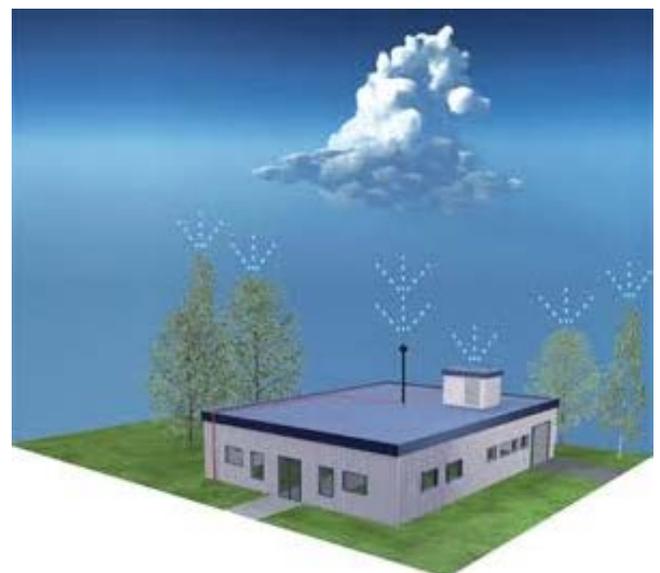


Fig 3. Early streamer emission method

The early streamer emission method uses franklin rod with a radioactive materials like radium and thorium source for generating ions. These are connected to the conductor cables and ultimately to the ground rods [6]. This method analyses the voltage in air surrounding the building area which is to be protected. When the electrostatic field is high then the conductors produces an upward streamer which reach the downward leaders to form a lightning. The lightning is thus absorbed and passed to the ground, and the damage is avoided satisfactorily [7]. The advantage with this method is that with the same lightning conductor we can protect many different structures and its surrounding and it is economical to install. The disadvantage is that it requires a minimum lightning conductor height of about 2 metres and the mechanical withstand constraint is less [8].

## **4.CONCLUSION**

This research paper focuses on the lightning protection system for protection of building from lightning strokes. The various methods of lightning protection system are also discussed. The lightning protection system is necessary for the protection of buildings from damage, fire hazards and safeguarding human life occupying the building.

## **REFERENCES**

- [1] Seema P. Navghare, Richard N. Anthony, “Introduction to protection of building from lightning strokes”, IJEE (Vol.4, No.2), Page 12-14
- [2] [www.electricalknowhow.com/2014/01/types-of-lightning-protection-systems.html](http://www.electricalknowhow.com/2014/01/types-of-lightning-protection-systems.html)
- [3] [www.nfpa.org](http://www.nfpa.org)
- [4] NFPA 78, National Fire Protection Association, Boston, 1989
- [5] [www.dtic.mildtic/pdf](http://www.dtic.mildtic/pdf)
- [6] Donald W. Zipse, IEEE transactions on industry applications, vol. 30, no.5, September-october 1994, 1351 Lightning Protection Systems
- [7] [www.scribd.com/early-streamer-emission-technology/pdf](http://www.scribd.com/early-streamer-emission-technology/pdf)
- [8] [www.earlystreameremission.com](http://www.earlystreameremission.com)
- [9] [www.franklin-france.com](http://www.franklin-france.com)