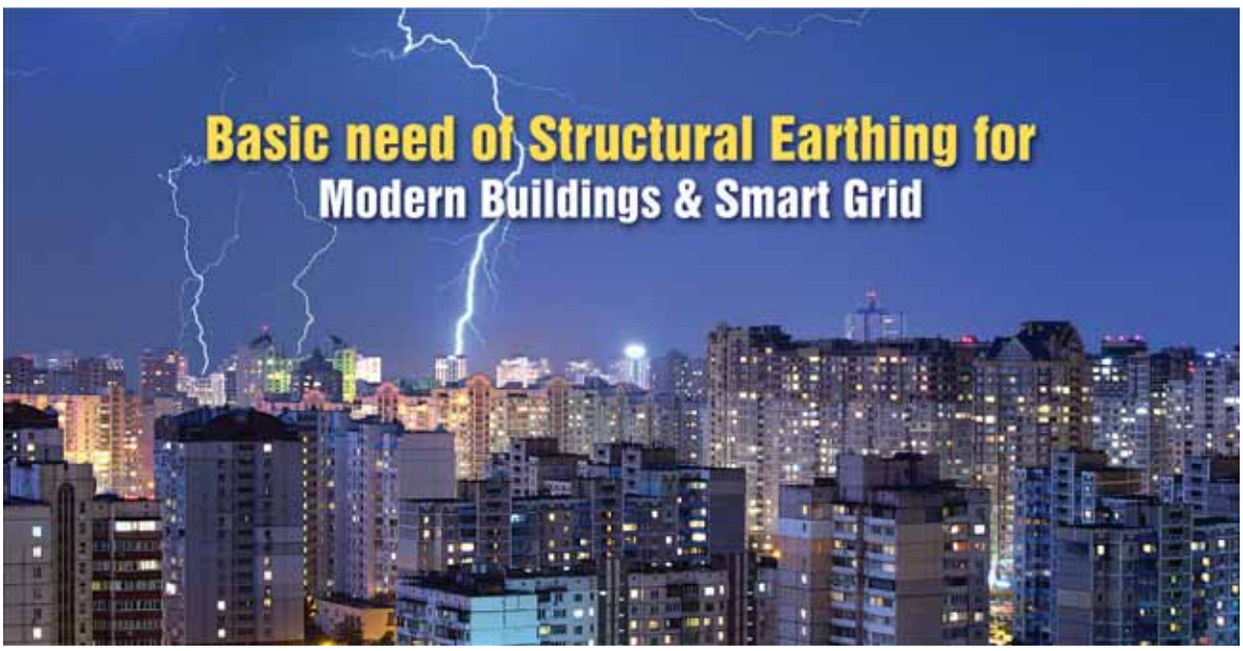


Lightning have always been a fascinating natural phenomenon. However, they also present a risk for human and the environment that should not be underestimated. The task of a lightning protection system is to intercept lightning strikes, divert it towards the earth and distribute in the ground. The idea is to prevent thermal, mechanical, electrical and electromagnetic effects that cause damage to the building to be protected, or humans through contact or step voltages inside the building

More frequently, today's electronic aids are damaged by Electromagnetic effects of lightning (EMP) as well as switching of electrical equipment. Taller buildings with number of electronic aids are more vulnerable. One of the example is failure of drives in LED lights.

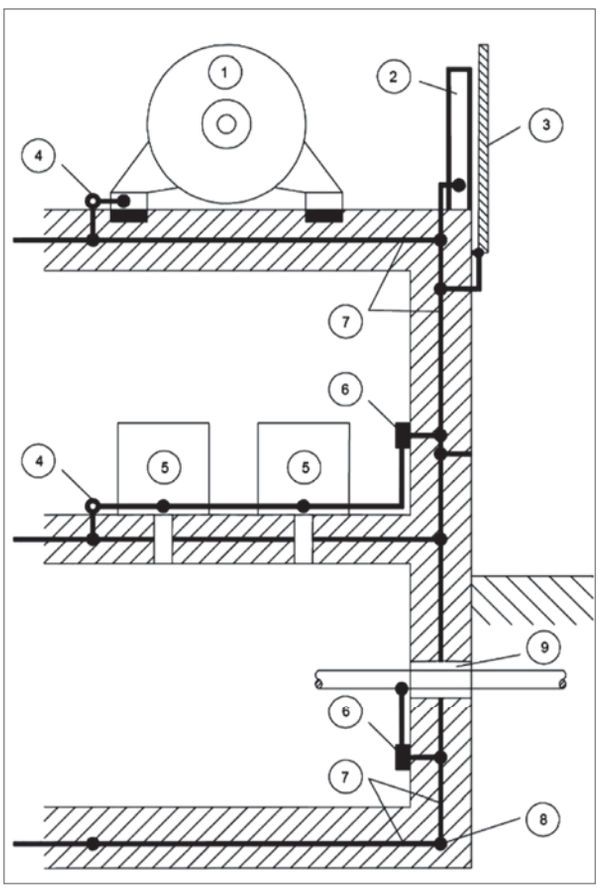
For last several decades IS2309 was followed as the standard for lightning protection installation. This standard do not explains much about the protection of electronics. Unfortunately in several high raise buildings not only the standards are neglected, but nonstandard practices are conveniently followed. Some examples are - Lightning Down conductors are routed through shafts with number of bends which can create flash over, explosion and fire. Insulated down conductors are commonly used with out understanding the science behind lightning current.

Improvement of construction techniques plays a major role in increasing the efficiency of a building against EMP, which is unfortunately not followed in most of the buildings due to the lack of awareness. Implementation of new IS standard for Lightning Protection IS/IEC 62305 opens a new topic of information, which is the practice followed internationally for several decades. Effective protective measures should start from the foundation, and it is not the electrical engineer, but the designers and civil engineers involved in the preplanning of the building who should follow the techniques in the structural design itself.

An EMP is a short burst of electro magnetic energy. Such a pulse may occur in the form of a radiated field or a conducted electric current depending on the source and may be natural or man- made. EMP has become a known subject now a day due to science fiction movies and is also one of the widely researched subject where modern military weapons with EMP emissions are developed that can destroy electronic systems in specific places. Lightning is the largest natural EMP whose effects can destroy electronic equipment in a large area. This is due to the induced transient voltage in long wires created due to the magnetic field of lightning.

Various studies proved that that effects of Lightning EMP (LEMP) can be felt as far up to 2 Km's radius from the point of lightning strike. Modern electronic equipment are sensitive to electrical and electromagnetic disturbances in the installed environment. Reducing the effects of LEMP by the way of shielding and bonding will protect this equipment. Here comes the role of structural/civil engineer. By adopting simple improvements in the steel reinforcement in a building, the protection measures against LEMP can be achieved.

The new standard of Lightning protection IS IEC 62305 recommends the use of naturally available steel in a building such as steel reinforcement as down conductors and earthing. This Concrete Encased conductors connected to the building steel, making the building steel effectively grounded, is not only an efficient, but cost effective too. The availability of large amount of down conductors achieved by interconnecting the natural steel will reduce the EMP effects to large extent.



Interconnected concrete encased steel will work as a "Faraday Cage" and limit the EMP effects of a nearby and distant lightning strike too. Equipotential bonding of different steel installations and steel reinforcement in a building not only reduce the failure of electronic equipment, but increase the life of equipment too. This method of Equipotentialisation (Protective Bonding) is well accepted and appreciated by the structural engineers.

1. electrical power equipment
2. steel girder
3. metal covering of the facade
4. bonding joint
5. electrical or electronic equipment
6. bonding bar
7. steel reinforcement in concrete (with superimposed mesh conductors)
8. foundation earthing electrode
9. common entry point for different services

PEB buildings with metallic roof, metal wall cladding and main structure if interconnected together satisfying basic bonding requirements will ensure the protection of electronic systems against EMP.

Earthing of electrical system in a building is assumed and followed as a connection to soil with a metallic media such as rod/pipe or plate. In America, the national electric code does not favors the use of an earth rod/pipe/plate. It recommends to use metal underground water pipe, metal frame of building, concrete encased steel in foundation or a ground ring as earth electrode. Buildings without these only need a rod, pipe or plate for a connection to earth. Where as in India even though the Indian standards, which are in practice for several decades, recommend the use of steel in foundation as earthing, it is followed only in very few industrial installations.

Purpose of earthing for safety and for safe operation of a protective device is often over looked and hence the belief of connection to earth rod in soil with a very low resistance is given more importance in India.

Building with electronic installations need either foundation earth or ring earth for the reliable operation of the installation as strongly recommended in IS IEC 62305-3. Such an earthing system provides Equipotentialisation and hence the effects of transient currents are reduced. Statutory requirement of "earth pit" with a disconnector is not mandatory, if foundation earth is used. The belief of concrete encased foundation earth is often viewed with suspicion, due to the myth that "Concrete is an insulator".

Concrete used for the foundations of buildings has a certain conductivity and generally a large contact area with the soil. Therefore bare metal electrodes completely embedded in concrete can be used for earthing purposes, unless the concrete is insulated from the soil using insulating material against ingress of water. Due to chemical and physical effects bare, copper coated or hot-dip galvanized steel embedded in concrete with a cover depth of more than 50 mm are highly protected against corrosion, normally for the whole life-time of the building. However Galvanised steel inside concrete need detailed analysis due to the effect of Galvanisation in concrete. Copper, Stainless steel or Copper coated steel are the best materials for this application in Indian environment.

Creation of a concrete-embedded foundation earth electrode during the erection of the building is an economical solution to obtain a good earth electrode with long life because:

- it does not necessitate additional excavation works
- it is erected at a depth which is normally free from negative influences resulting from seasonal weather conditions
- it provides a good contact with the soil
- it extends over practically all of the building's foundation surface and results in the minimum earth electrode impedance which can be obtained with this surface
- it provides an optimal earthing arrangement for lightning protection system purposes, and

- from the beginning of the erection of the building, it can be used as an earth electrode for the electrical installation of the construction site

In addition, the concrete-embedded foundation earth electrode provides a good basis for the main protective bonding.

If insulating measures against water (e.g. using plastic sheets under floor) are used, earthing using the foundation concrete is not viable. In such cases, the positive effect of metal reinforcement for protective bonding may be used, and for earthing purposes another earthing arrangement should be used, e.g. an additional concrete- embedded foundation earth electrode below the insulated foundation, or an earthing arrangement around the building or a soil-embedded foundation earth electrode.

Special care, material and expertise is required to avoid corrosion in places where the steel inside concrete is exposed outside. The newly published IS/IEC 62305 provides detailed information about the special measures. Implementing these protective bonding techniques along with surge protective devices for power, voice, data, communication lines etc in new buildings not only saves cost, but will effectively protect electronic system against EMP including the ill effects of lightning.

Conclusion

- Modern Buildings need not only lightning protection, but protection of electronics against EMP too
- IS/IEC 62305 – 1 to 4 is the new IS standard for lightning protection
- NBC 2015 (draft) also recommends the use of Lightning protection as per IS for new buildings based on risk assessment calculation.
- NBC 2015 (draft) also provides thumb rule calculations to decide class and selection of LPS
- Use of Structural steel for lightning protection in RCC and PEB
- buildings will increase safety and reliability of protection
- Use of Galvanised Iron inside RCC need detailed evaluation and not recommended for several applications
- Copper, Stainless steel or copper coated materials are recommended for ring earthing if connected to structural steel. ■

Mr. S. Gopakumar

Managing Director of CAPE Electric Pvt Ltd.
Member of National Building Code
(Electrical Committee)