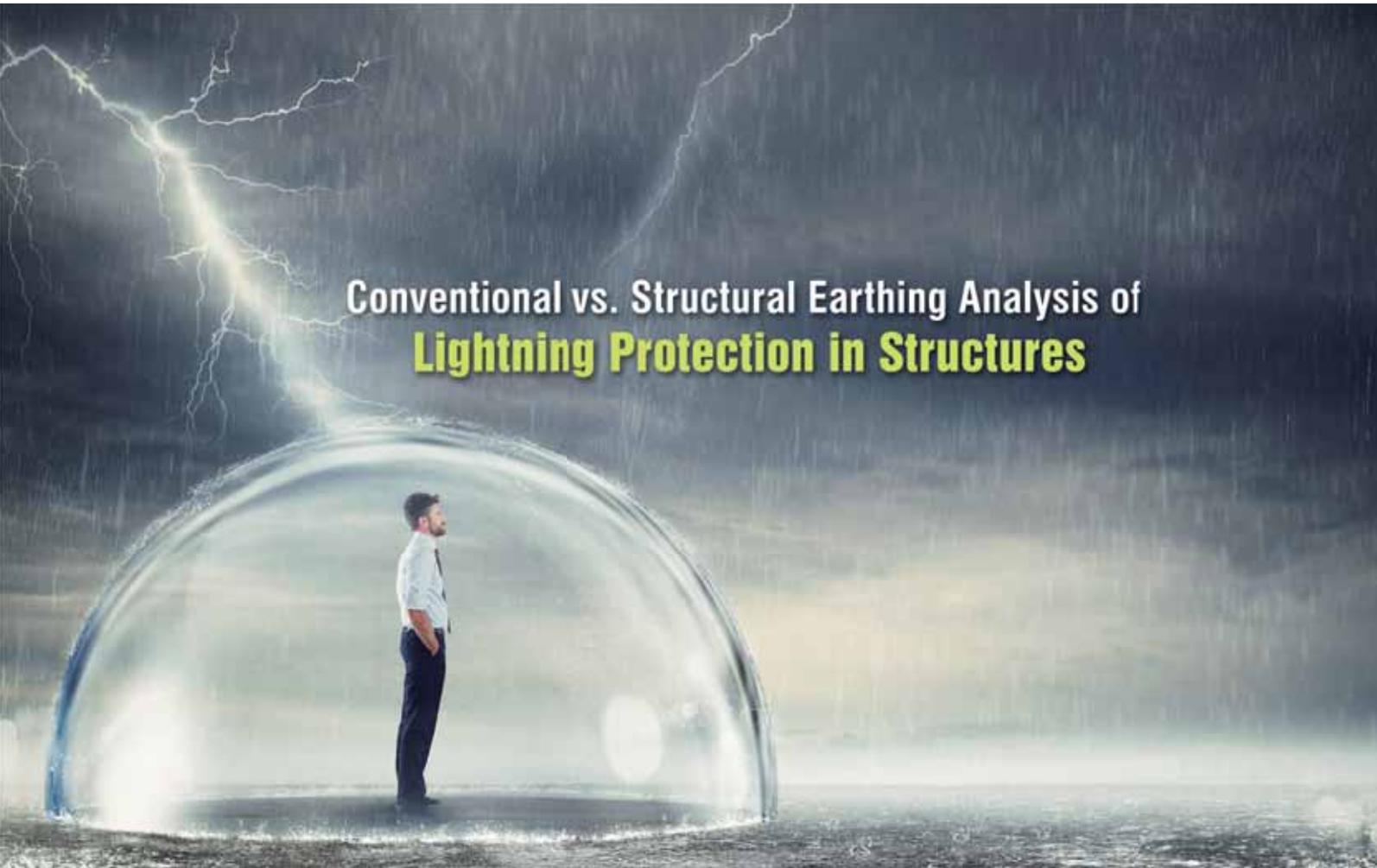


## Conventional vs. Structural Earthing Analysis of Lightning Protection in Structures



Lightning Protection of structures are being done in 2 ways, both conforming the Indian Standards. The first method is isolated protection (for convenience called as conventional method in this paper) and the second one is to use the naturally available steel in buildings as parts of LPS such as down conductor and earthing (for convenience called as structural earthing in this paper).

In conventional method down conductors are outside the building and generally isolated form the structure. Vertical Earthing electrodes are used which are also outside the building. Generally the LPS is not connected to Equipotential Bonding bar, but in some cases earth electrodes are connected to other earthing system

In structural earthing method, continuous conductors super imposed inside columns and foundation which runs along with construction steel will do the job of down conductors and earthing.

### Analysis on injury to living being by electric shock due to a direct lightning strike in the structure

IS/IEC 62305-2 explains the risk assessment and probability of damages in a building during a lightning. Probability of injury to living being due to touch and step potential ( $P_A$ ) in a building depends on the protection measures provided in the building against touch and step potentials (PTA) as well as the external LPS provided (PB).

$$PA = PTA \times PB$$

Protection Measures (touch and step potential)	$P_{TA}$
No Protection measures	1
Warning notices	$10^{-1}$
Electrical insulation of exposed LPS parts	$10^{-2}$
Soil equipotentialisation	$10^{-2}$
Structural Earthing	0
Protection Measures (Physical Damages)	$P_B$
No protection measures	1
External LPS Class IV	0.2
External LPS Class III	0.1
External LPS Class II	0.05
External LPS Class I	0.02
Air termination (Class I) + structural Earthing	0.01
Metal roof + air termination (class 1) + structural earthing	0.001

Protection measures	$P_A$	Safety Probability
No protection measures	1	Each strike will create damage
Class IV external LPS and no soil equipotentialisation	0.2	One strike out of 5 can create physical damage

Class I with no protection measures $P_{TA}$	0.02	One strike out of 50 can create physical damage
Structural Earthing	0	NO Chance of Damage

## Electrical Safety and Power Frequency Fault Voltage

Industrial / IT and commercial establishments generally use TN-S network for L.V electrical distribution with in the facility. For establishments with number of electronic systems, TN-S is the recommended network by every latest standards . The method is explained and recommended in IS 3043 as PME (Protected Multiple Earthing).

Properly implemented structural earthing ensures easy implementation of PME and there by reduce the power frequency fault voltage between electricity using equipment and extraneous conductive parts in a building during a fault. Equipotential bonding thus created avoids dangerous spark over and fire during a fault

## Protection of Electronics

Modern day electronic installations are highly sensitive to Transients. Transients in a building are created due to radiated Electro Magnetic Pulse (EMP) due to various reasons. Future electronic installations will be smaller & faster which means more sensitive to EMP. Electro Magnetic Shielding plays a major role in protecting modern day electronics.

A properly installed Structural Earthing system mean a large volume shield created by natural components of the structure such as the metal reinforcement in ceilings, walls and floors, the metal framework, the metal roofs and metal facades. These components together create a grid-like spatial shield (faraday cage). The current injected into the reinforcing rods is assumed to flow through a large number of parallel paths. The impedance of the resulting mesh is thus low and, as a consequence, the voltage drop due to the lightning current is less. The magnetic field generated by the current in the reinforcing steel mesh is weak due to the low current density and the parallel current paths generating opposing electromagnetic fields. Interference with neighboring electrical conductors is correspondingly reduced.

With out any doubt, structural earthing Provides the best equipotentialisation and protection of electronic systems.

## Corrosion and Associated problems

Steel inside concrete have the advantage that, if the concrete is of adequate construction and covers the steel by at least 50 mm, they are reasonably protected against corrosion, throughout the life of the building. Where as a conventional LPS is subjected to corrosion,



theft, vandalism etc hence need periodic inspection and maintenance

A properly installed Structural earthing system is permanent in the building well shielded provided welded iron reinforcing bars are used for concrete outer walls. Note that a good electrical bond is necessary. In several situations the steel reinforcing bars may not represent an adequate shield. An well-designed and implemented lightning conductor with conductive connections to structural steel is an alternate method. Some tips about this conductor are

1. Galvanised steel inside concrete may create problem to concrete and hence avoid GI inside concrete.
2. All penetrations of steel in reinforcement to an outer area need careful design and installation. Use only Copper, Copper coated steel or SS material for this application.
3. Use only copper, copper coated steel or SS in soil if connected to steel in reinforcement as recommended in IS/IEC standard.

## Cheap and Best in long run

To achieve a cost-effective and efficient protection system, the design should be carried out during the building conception stage and before construction. This allows one to optimize the use of the natural components of the structure and to choose the best compromise for the cabling layout and equipment location. For a retrofit of Shielding measures in conventional LPS the cost is generally higher than the cost for new structures.

## Structural earthing and Bonding system

- > More safety for human beings during lightning
- > More safety for electrical installations during fault & lightning
- > Protect Electronic systems against EMP
- > No Corrosion and Less Maintenance
- > Cheap and Best in long run

Structural Earthing is a standard construction practice in developed countries. ■