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# Rooftop Site Grounding

Technical Note

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## Rooftop Site Grounding

In most urban high rise sites a low inductance earth ground connection is impossible to achieve. A connection to the steel structure of the building is the preferred method to connect a single point ground. In some poured concrete buildings there is no steel structure, only reinforcing bar in the concrete. If local building codes permit, attach the single point ground to any exposed rebar. Long inductive ground conductors down the building can also be used for the final earth ground connection. This is a poor way, but sometimes the only way to ultimately connect to earth ground. When using this method, (or any method) protect every interconnection to the outside world. Power mains, telephone, control lines, or any other outside connection must have a protector referenced (connected) to the single point ground. When a strike occurs, the top of the building will quickly elevate in potential (compared to the outside world). Depending on the earth ground connection, the following could occur:

- Connected to building structural steel - The elevated potential first charges the capacitance of the structure. The capacitance absorbs some of the fast rise time energy and disperses it throughout the structure and down to the building footers and any interconnecting conductive pipes. The equipment on the roof is elevated in potential with a relatively fast decay to  $\frac{1}{2}$  peak voltage.
- Connected to building reinforcing bar - The elevated potential propagates through the tied together rebar bundles and conductive concrete towards the footers and interconnecting pipes. There is usually dc continuity through the rebar bundles to the footers. The roof top equipment is elevated in potential more quickly (than above) with a slower decay time. There is more “time” for damage to occur.
- Connected to a standing water pipe or “fire riser” - First, get permission to connect to this conductor. Make sure there is continuity all the way down - no PVC fittings or insulating gaskets. Bypass basement pump flanges with copper strap and protect the pump motor windings with an ac protector. The standing water pipe is usually a large diameter pipe with circumference / surface area much greater than a typical earth down-conductor. Use this method with caution.
- Connected to a single (or more) earth downconductor - The elevating potential quickly saturates the current carrying ability of the single (inductive) downconductor. The equipment is elevated to a high potential and stays there until the single downconductor can “drain” away the charge. The equipment is held at high potential for a much longer period of time than any of the above options.

If there is a “lightning rod” system installed, it is OK to use the lightning rod system downconductors as an earth ground as long as the protected equipment is also on the roof. Code requirements will probably insist on this connection. The equipment cabinet is on the roof, the potentials will be the same. If the equipment is on a lower floor, do not bond equipment or protector grounds to the Air Terminal down conductors! Find structural steel or route separate low inductance conductors from the protectors directly to earth ground.

The Air Terminals send up an upward going streamer in the presence of a downward moving step leader. When they connect, a path for the main lightning stroke is established. The Air Terminals are designed to attract a lightning stroke to themselves rather than the building structure. This reduces damage to the building structure, but concentrates the stroke current on the Air Terminal’s down conductor. The fast rise time, high current pulse creates a distributed voltage drop across the length of the down conductor. This instantaneous peak voltage can be hundreds of KV!

If any other "ground" conductor were connected to the air terminal's down conductor somewhere along its length, a very high voltage (referenced to earth) could occur at that connection. This high peak voltage could exceed the "turn on" threshold of both protectors and switch energy back through the connected critical circuitry towards chassis ground. This potential difference would cause current flow through the critical circuitry towards any other building ground connection. The circuitry would probably be destroyed in the process. If there were separate equipment / protector ground conductors, connected below earth to the ground system, this would not occur.

See sample cut-away high rise building below.

### High Rise Building "Cut-Away"

