

Tower grounding is key to equipment protection because it reduces the surge load on other grounding components and protective devices. When lightning hits a tower it is critical to get as much of the potential as possible harmlessly to earth so that as little as possible enters the shack.

First, some fundamental issues must be understood.

1. The electrical potential from a lightning strike is at a very high voltage, and as such it rides on the surface of a conductor.
2. Lightning is massive flow of electrons and therefore has a 'mechanical' component. The current has momentum and as such does not make turns easily. Although the current flows at near the speed of light, the electrons move through a conductor at around 17 feet per second.
3. A lightning strike on a tower can be a direct main discharge strike or it can be an upward streamer where the main strike is somewhere close by. The most common tower strike would be a streamer.

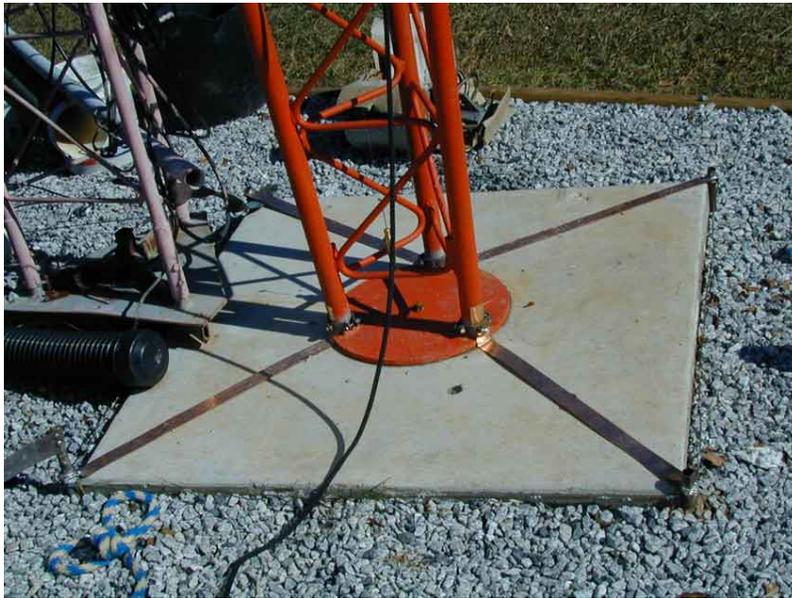
Assuming a main strike (which is the subject here), the potential builds from a tower ground to a cloud; an upward streamer meets a downward leader. Whatever the state of tower grounding, the process has started. The main strike follows the streamer-leader connection and comes down the tower leg(s). Because of the extreme voltage, the current is riding on the surface of the tower legs.

So, what happens when this irresistible force meets the immovable object, (the concrete at the base)? This is the key – recall that this force does not want to change direction. Consider this installation:



This tower is grounded through conduit to the outside of the concrete. This is absolutely no problem unless the tower is subjected to a main strike. A main lightning strike will break the concrete because the potential will be split at the ground connection. A relatively small amount will take the tortuous path through the conduit but most of the current will not change direction and will continue down through the concrete into the earth below. The concrete will split on one or more tower legs. (Considering the proximity of this tower to other residences, (not to mention the removal of a large tree), this Ham may have a significant problem with his neighbors as well)!

Here is another example of a tower that is well grounded but will not survive a main strike.



The problem is that, in most cases, the concrete base size necessitates an excessively long right-angle path to ground. This example is likely to produce some St. Elmo's Fire.

So, what is the solution? I offer two.

First would be to ground each tower leg several feet up from the base and angle the conductor down to the respective ground rods outside the concrete base. The smaller the angle between the ground conductor and the tower leg the better.

However, in the case of a smaller tower, such as a Rohn 25 or 45, why not ground in the middle of the tower? The ground conductor cannot be encased in concrete, (touching the concrete), because the integrity of the concrete would be compromised.

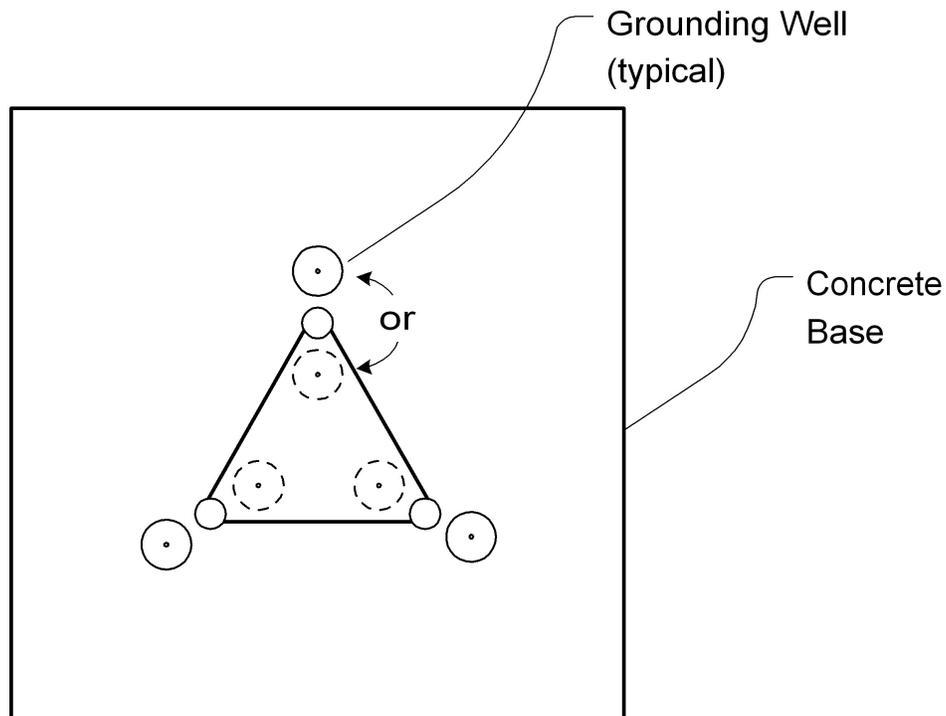
In the following example, conduit is placed in the concrete form and the ground rod is driven through the conduit.



In this installation, the ground rod is equidistant from each tower leg and very close to each. Three ground straps will converge on the same ground rod. There will be a very small angle between the ground straps and the tower legs hopefully taking most of the current down the center but not touching the concrete. Yes, this is not a good example because the concrete base is small, but normally there would be much more concrete. This is a retirement income installation.

The conduit will be filled with sand as an insulator. A main strike will probably turn the sand into a glass insulator.

For a commercial application on a large tower, I would recommend grounding wells for each tower leg something like this:



My installation with a single rod in the middle of the 25G tower is an experiment because experimentation is what Ham Radio is about. It is an inexpensive adaptation of ground well techniques used on large building structural members where the grounding must be through the concrete.

My tower is at the apex of a hill and so the probability of a strike is high. I will report on the results, good or bad.

73 de NA5RC