

December 2010 letter to QST technical correspondence

From Rudy Severns N6LF

My March 2010 QST article on ground systems for verticals (and the QEX series of articles) confirmed that a simple 4-radial elevated ground system could perform as well as one with a large number of radials on the ground. That's all well and good but there was a point which I failed to emphasize which may have led some to think you could just throw up any 4-radial system and get results equivalent to a ground based system with numerous radials. In the real world, that's simply not the case!

During the experimental measurements on the elevated 4-radial system I noticed that the results were very sensitive to even small changes or asymmetry in the radials. To get results equal to 60 radials on the ground, I had to carefully verify that the currents in all four radials had the same amplitude and phase and that the radial current phase and amplitude sum agreed with the current in the base of the vertical. In short, I had to be a fanatic with the radial layout details! Some years back Dick Weber, K5IU showed experimentally how asymmetric radial currents could be in typical 4-radial elevated systems (Optimum Elevated Radial Vertical Antennas, Communications Quarterly, Spring 1997). Arch Doty, W7ACD, has shown how sensitive the current distribution in elevated counterpoises can be to soil variations under the counter poise (Improving Vertical Antenna Efficiency, CQ, April 1984). We really have been warned about this problem!

Since my QST article I've done some modeling to explore the sensitivity of a simple 4-radial system to asymmetries in the radial fan. The modeling easily replicates Weber's results and the news is even worse than Dick thought! The 4-radial system is indeed very sensitive to quite small irregularities and/or nearby conductors. It's easy to demonstrate pattern distortions of 2-3 dB and increased ground losses of 1-2 dB and these are by no means worst cases. More importantly, the modeling shows that as the number of elevated radials is increased the sensitivity goes down quickly. Elevated systems with 10-12 radials are not very sensitive to reasonable asymmetries. It turns out that a number of hams have observed significant improvements in their elevated systems by going to 10 or more radials. Both modeling and experiment seem to agree.

I doubt that the average 4-radial system is actually performing as "advertized". No doubt there are exceptions but the advice I presently give is to use 10 or more radials whenever possible in an elevated system.

73, Rudy Severns N6LF