Antenna of the Month

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Half-Sloper

Of all the oddball antennas I've worked with, the **half-sloper** is definitely one of them. It consists of a vertical element (typically a tower) and a single sloping quarter-wave counterpoise wire, fed at the junction at the top. It will provide primarily low-angle vertical radiation, a slightly directional pattern, and good SWR bandwidth. The trick is to get it adjusted for a decent match, something nearly every builder struggles with. One thing is for sure, every half-sloper installation is different and it's almost mandatory to do some simulation to get an idea of how it might work out.

These antennas are most commonly chosen for 80 and sometimes 160 m when no other geometry will work. That was the case at my remote station, W6SRR, where the tower is quite short and the property owner could barely be convinced to allow us to run even a single wire across the property let alone a nice stand-alone vertical or something more elaborate.

Operating Principles

In *Low-Band DXing*, ON4UN comes to the same conclusions that I have regarding how the half-sloper works: Both the vertical tower and the sloping element contribute to the basically omnidirectional pattern. Most of the low-angle vertical radiation comes from the tower, and a significant amount of horizontally-polarized radiation at high angles comes from the horizontal component of the sloping wire. Directionality will depend upon ground qualities, likely being more directional over poor ground. In effect, it's more like a top-loaded vertical with a single tuned counterpoise.

Antennas on top of the tower act as capacity hats, effectively lengthening the tower, which can be helpful. Having a tower that's near an electrical quarter-wavelength seems to make it easier to obtain a good match. Also, it's not unusual to see the SWR of the half-sloper vary a bit as a Yagi is rotated, especially if the sloping wire is very close. Keep in mind that *any wire antenna anywhere near a Yagi can easily alter it's pattern* on frequencies where that wire is resonant!

Ground radials are required though the demands are typically not as great as for a regular ground-fed vertical because the current at the base of the tower is diminished. Having the high-current point well-elevated improves effectiveness of a half-sloper.

Because there is high RF current flowing on the surface of the tower, all cables leaving the tower near the base require robust common-mode chokes. Otherwise they will act as additional radials and will conduct significant amounts of RF current into the shack. Running all cables *inside* the tower is helpful.

Another problem can arise at the balun on any antennas atop the tower. High common-mode current may be present. If the choking impedance of the balun is insufficiently high, it may heat up, possibility to destruction. Simulation of my system showed very high dissipation (tens of

Watts) in the balun. For that reason, a relay was added that shorts the driven element of the Yagi to ground. This same problem can happen anytime a tower is driven, for instance with a shunt-feed arrangement.

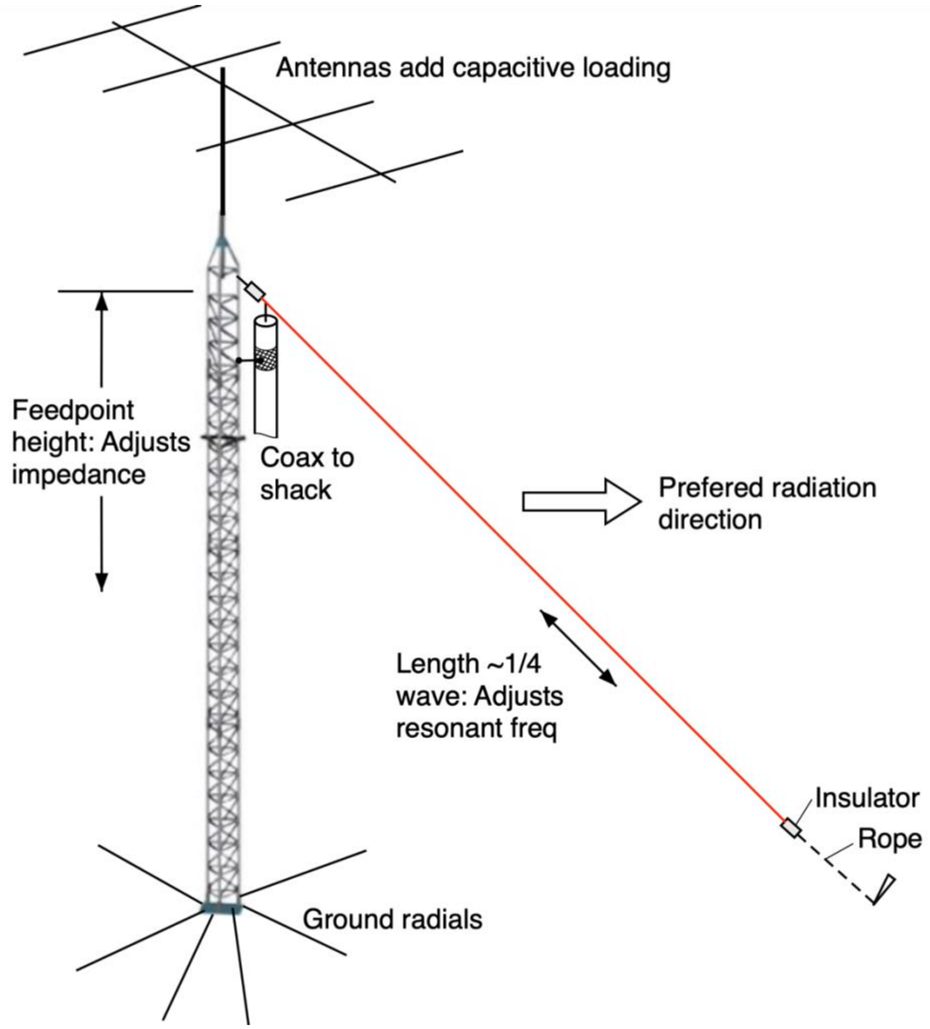

Figure 1. Overview of the half-sloper geometry.

Matching

Simulation and experiment have shown that a reasonable impedance match to 50 ohms can often be obtained by adjusting the feed point elevation. Then the counterpoise wire is trimmed for resonance. These adjustments interact and experimentation is required. This is like any off-center fed antenna, where the choice of feed point location will set the basic impedance. And as I said, every installation is different so it's impossible to give you simple rules of thumb. Some stations seem never to obtain anything near 50 ohms and require a matching network.

For my 80 m half-sloper, simulation showed that moving the feedpoint upward increased impedance by 3.4 ohms per foot and increased resonant frequency about 30 kHz per foot. Your setup will no doubt be completely different. But having tuning estimates like these available makes it easier to adjust in the field and that's another good reason for simulation.

Performance of the W6SRR 80 m Half-sloper

I simulated my 80 m W6SRR setup in EZNEC with the NEC5 engine. We have a 30-ft tower with 14 ft of mast and multiple antennas on that. There are a 9 radials in the ground covering a half-circle. The sloping wire actually goes down a real slope since we are on a hilltop and it is oriented toward Europe. The effects of that physical slope can't be modelled with NEC but are usually beneficial in lowering the takeoff angle [Ref 1].

Figure 2 shows the currents in each conductor. Note that the highest current is actually on the upper part of the tower rather than the lower part, which makes the radial field less critical. The match ended up nearly perfect and the 2:1 SWR bandwidth is about 200 kHz, typical for wire antennas. We then used the a quarter-wave coaxial matching section trick popularized by Dave Leeson, W6NL [Ref 2] to allow our antenna tuner to cover the entire 80 m band.

Patterns are shown in Figs. 3 and 4. Peak gain is fairly low, a bit below 0 dBi at a takeoff angle of 36 degrees. A low dipole would be even worse, so I consider this a win. Assuming my choice of ground constants was in the ballpark, we might have as much as 10 dB of rejection off the back which is toward Oceania. And yet we are able to work them just fine so it may not be that much. As expected, there is significant horizontally-polarized radiation off the side and straight up. This antenna works fine for short-haul contacts.

By the way, we also built a 160 m half-sloper with a similar arrangement as the only possible way of accessing that band. Gain is even lower, -6 dBi at best, and we have a difficult time getting out. We do hear very well with both of these antennas, which is the good news. This one is a case of. "just because you can hear them does *not* mean you can work them."

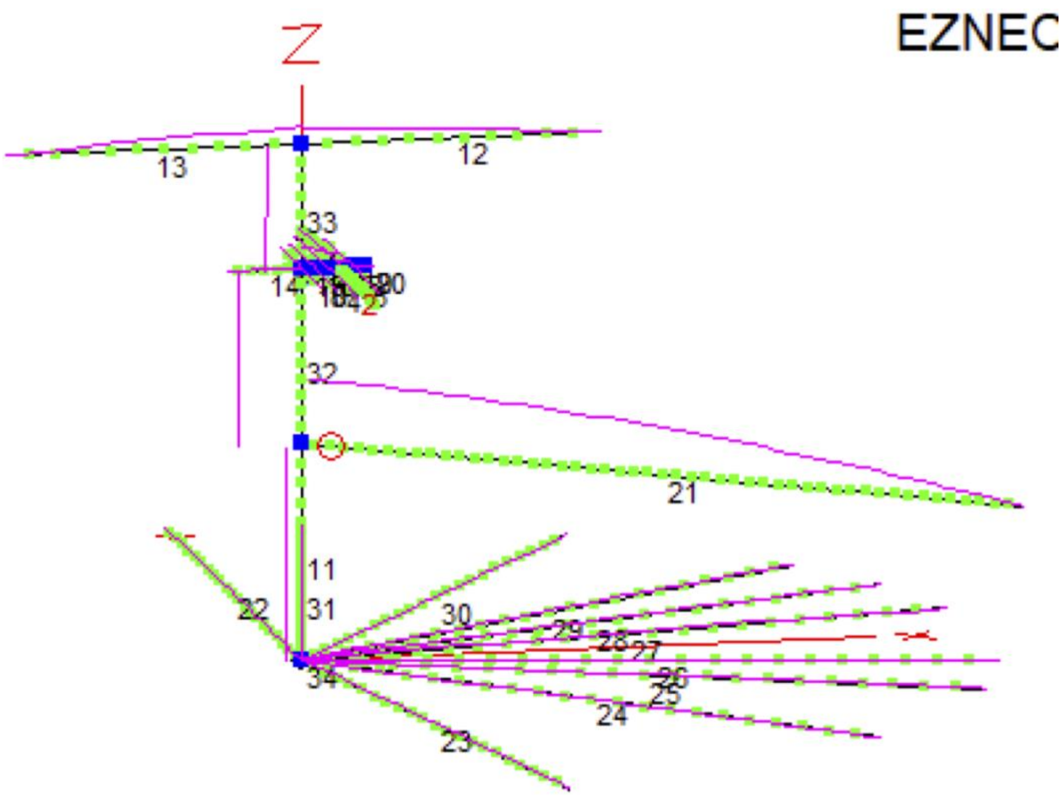

Figure 2. Current distribution in my 80 m half-sloper. Pink lines are current magnitudes.

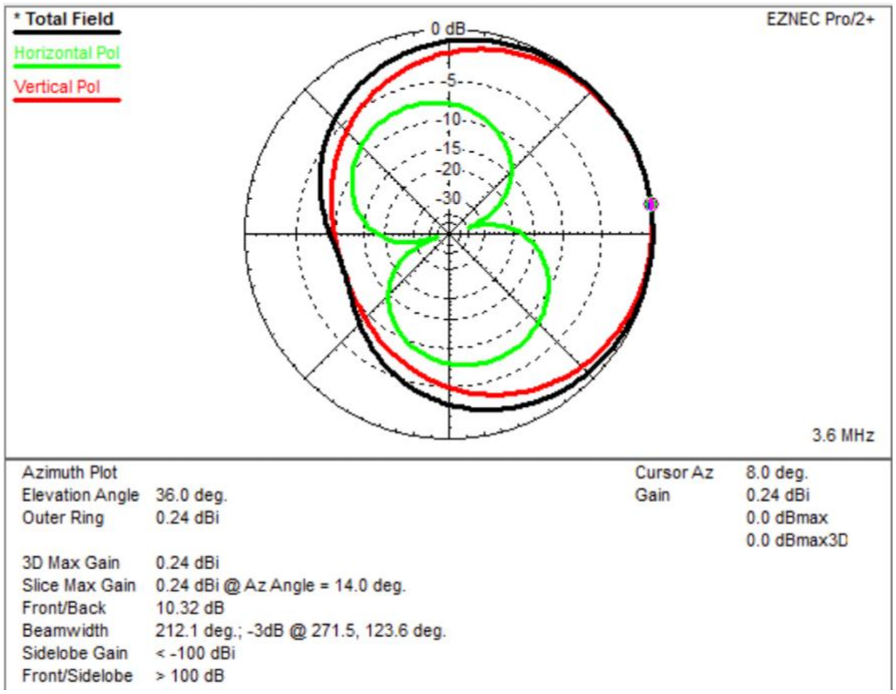

Figure 3. Azimuth pattern. Peak gain (0.24 dBi) is in the direction of the sloping wire.

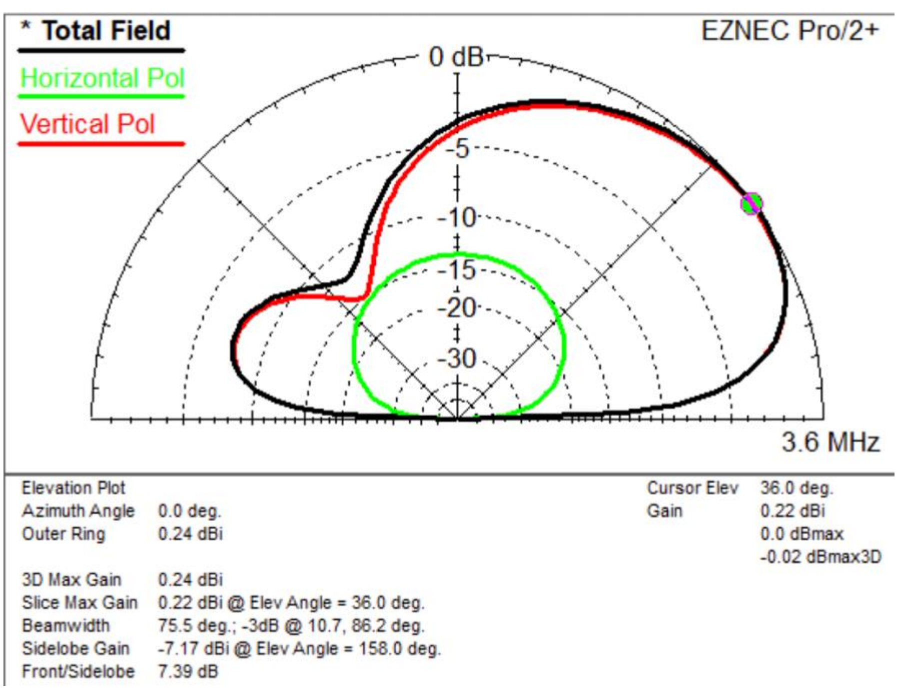

Figure 4. Elevation pattern in the direction of peak gain.

Conclusion

Half-slopers performance is a bit unpredictable but can fill a need in some situations. I would prefer an inverted-L or some other design but it's certainly better than no antenna. Before building one of these, you really need to simulate it to get an idea of how it might behave. At least it's not complicated or expensive to build.

References

1.Tom Schiller, N6BT, *A New Look at Verticals*, https://ncjweb.com/features/mayjun19feat.pdf

2. Dave Leeson, W6NL, *The Story of the Broadband Dipole*. http://ncjweb.com/features/QEX-Leeson-Broadband-Dipole.pdf