Jim Streible, K4DLI

A 160 Meter Antenna for the Acreage-Challenged Ham

Those of us who live on a city or subdivision lot know how difficult it is to install an antenna for 160 meters. Let's face it, 160 meter antennas are *big*! Not everyone can install a quarter-wave vertical with 120 or even 64 radials. In my case I live on a 100×200-foot lot in a subdivision. With the house about one-third of the lot depth back from the street, that does not leave much room in the backyard for antennas.

Getting Acquainted with Top Band

My first encounter with 160 meters was back in the late 1950s, when I acquired a World War II-era surplus transceiver — I believe it was a BC-669 — and strung up a wire about 75 feet long. The BC-669 had an antenna matching network that would load the proverbial "wet noodle," since it was designed to work into a 15-foot whip antenna. Because LORAN (Long-Range Aid to Navigation) used this part of the spectrum, 160 meters was split into segments — I don't remember all the details — and had power limits for daytime and nighttime use. In some areas, a lot of the band would be covered by distinctive LORAN pulses. I made a handful of contacts and dismissed the band as pretty much useless.

About 20 years later following a couple of moves from Kentucky to Georgia and some years of inactivity, I joined the Southeastern DX Club in Atlanta and started chasing DX. A number of members were big into 160 meters — K4TEA, K4PI, K4UEE and several others. They were always talking about what they had worked on 160 and got my interest in the band going again.

In Search of a Better Antenna for 160

The first antenna I tried was an inverted L. It worked okay on local and close-in DX, but I wasn't working the DX the others were talking about. Since I was new to 160, DXing anything was "a new one," and I keep at it for a while.

A few years earlier, I'd become involved in modeling antennas with *NEC*, so I decided to see what I could come up with for an antenna that would fit in my backyard and exhibit a lower angle of radiation. At one time I had a 40 meter vertical loop between the tower and a pine tree, and it worked very well. For 160 I decided to try a vertical loop with the lower horizontal leg on or *in* the ground.

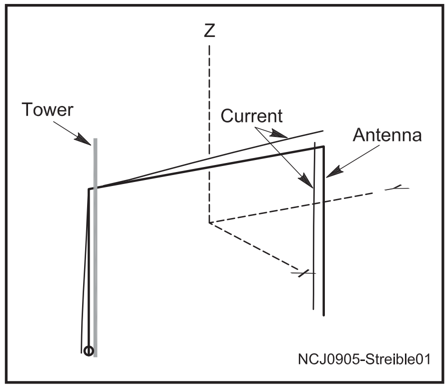

Figure 1 — Vertical current pattern of original grounded loop

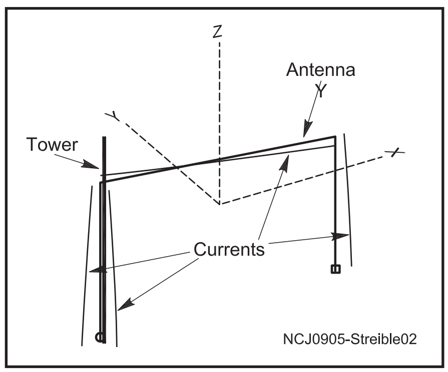

Figure 2 — Final antenna configuration

I measured the amount of space available to install an antenna and found I could get 90 feet horizontal and 55 feet vertical. At that time I had a quad on the 70 foot tower and could not go any higher and still clear the antenna when the quad was rotated.

Since *NEC 2* would not handle wires *on* or *in* the ground, I "placed" the wire as close as possible to the ground and plotted the vertical and azimuth patterns. *Not bad*! The angle of maximum radiation was about 30°. The azimuth pattern was nearly circular, since the vertical legs were not far enough apart to give any directivity. Gain was minimal, but I figured that on 160 any gain was better than none.

A Brass Radiator?

I installed this antenna and built a matching unit to get the impedance to 50 Ω. I also installed some more radials (I had a few for the inverted L) at the tower base. I could only go in one direction, since the tower is up against the back of the house. The antenna worked, and I was making contacts on 160 and building my country count. Then I got another idea. What would happen if I grounded the far vertical leg?

According to *NEC 2*, this would produce a deeper null in the overhead pattern and a take-off angle of about 26°. With this setup I would need some radials at the far vertical section. I started to install some, and with each radial I put down I had to readjust the matching unit. Then I remembered something I had read in the 1950s about how some of the old timers would get a good ground. They'd go to an auto junk yard and get an old brass radiator and punch some holes in the core. Then they'd attach a ground strap, dig a hole and bury the radiator upright with just the filler neck sticking out of the ground. When they filled the radiator with water, it would seep through the holes and keep the ground wet. By all accounts, this seemed to work very well. Now, just try to find a brass radiator these days.

Making It

Instead, I went to the local hardware store and got a 3×3-foot sheet of aluminum, attached a ¾-inch strap, painted both sides with aircraft-grade zinc chromate and covered the strap joint with roofing tar. Then I buried the sheet flat about 3 or 4 inches deep. After that, I found that putting down or taking up radials did not change the feed point impedance. I can't explain it, but it worked for me, and it been in place for about 15 years. If I had room to install more radials, I am sure the current return would be better, but you live with what you *can* do.

Looking at the current distribution in the horizontal wire it appeared obvious that the current was not balanced in this wire. If it were balanced, there would be very little horizontal radiation; it would all be vertical (see Figure 1). The answer was to add loading to the ground end of each vertical leg and get the current null in the middle of the horizontal wire. This required 25.8 µh inductors at the ground end of each vertical wire. Figure 2 shows the results.

The tower is the fourth vertical wire modeled in the program. There is considerable

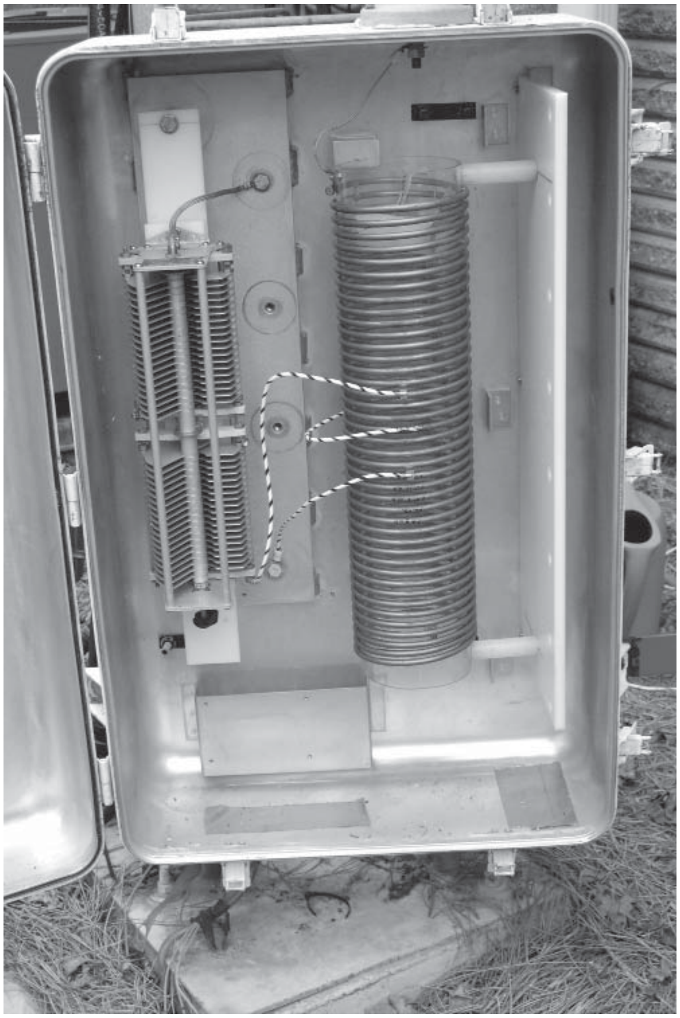

Figure 3 — Antenna matching network

Figure 4 — Far end loading coil

current induced in the base of the tower, and radiation from the tower is largely omnidirectional. *EZNEC* predicts the following currents at 1500 W to the feed point:

Feed point current	8.25 A
Far vertical base current	7.24 A
Near end of horizontal section	3.37 A
Far end of horizontal section	3.92 A
Base of tower	3.3 A

Elevation and azimuth plots as well as a comparison between the inverted L and inverted U versions are available on the *NCJ* Web site, **www.ncjweb.com/bonus.php**.

Loading and Matching

At this time I built a new matching network (See Figure 3) at the feed point and made this end of the loading from a coil I already had of ¼-inch copper tube. The coil was tapped up from the ground end — approximately at the middle of the coil — for a 50 Ω match, and a capacitor was used to tune out the reactance; the lower turns were left floating. Centered on about 1830 kHz, the antenna exhibits a bandwidth of ±35 KHz at the 2:1 VSWR points.

The coil on the far end was wound with #14 insulated wire on a PVC form and inserted into another PVC tube with end caps attached (see Figure 4). The end caps are drilled and tapped at 120° points around the cap and into the PVC tube, with 6-32 Nylon screws holding the caps in place. On the end that's at the base of the loading coil a bead of RTV was run around the junction of the cap and tube to prevent water from getting inside. The entire loading coil is painted flat black to protect it from UV radiation. Brass screws were used through the end caps, with ring lugs soldered to the heads. A flexible strap and ring lug on the other end were used to attach to the screw that connects to the coil. The end caps were center drilled and tapped for a tight fit, and RTV was applied to the screw threads near the screw heads to further prevent water ingress.

The Bottom Line

How does it work? On transmit, very well. Anything I have been able to hear I can work. At this time my DXCC count is 170 worked with 157 confirmed, and 30 zones worked with 29 confirmed. I'm not one who is up every morning for the gray line, nor am I there every night. By and large, if I know something is on that I need, I am there. On receive, it suffers the same as all vertically polarized antennas. It will pick up more noise than a horizontal antenna. I have just put up a K9AY Loop in the hope of improving my reception, but I fear it's too close to my transmit antenna. My two best contacts so far are VS6DO and 3B7C. I worked VS6DO right after I put up the first version of the loop.

If you have room to put up a version of this antenna, the dimensions are not very critical, but you will have to match the loading coils and input impedance to your configuration. The bigger the loop, the better it will work. If you have room to put up a loop that's a full wavelength in circumference, go for it.

I ran plots for one that would be 70 feet tall and 90 feet across, and it showed 2.16 dBi of gain at a take-off angle of 25°. Since I no longer have the quad on the tower, I may try to enlarge my loop next spring.

You won't match 160 meter stations such as W8JI, WB9Z or any of the "Big Boys" in the pileups, but you will be able to put out a respectable signal from an average-sized lot.

NCJ