Newcomers and Elmers Net: More Wire Antennas
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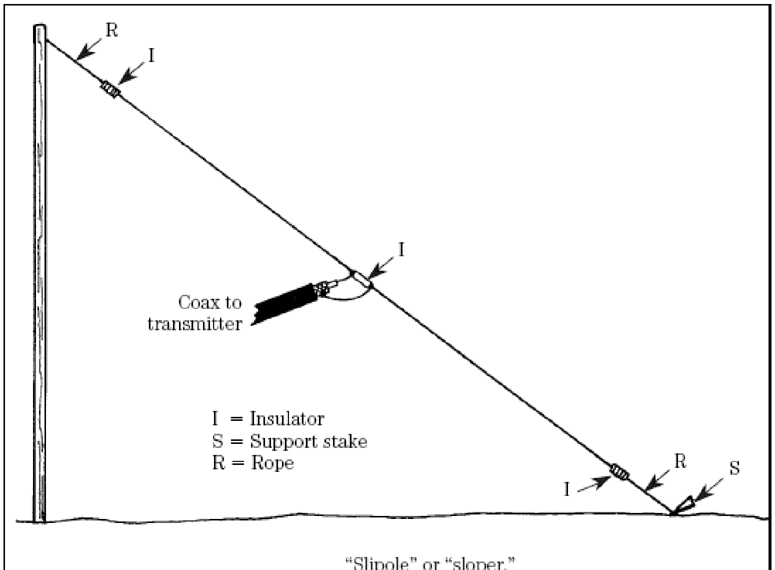
Antenna Construction Supplies
Antenna Construction Tools (Harbor Freight can be a good place to go)
Wire Cutters; Pliers (regular and needle nose);wire strippers; dummy load; 3M electrical tape; duct tape (of course!)volt/ohm meter (to check for coax continuity); insulators (I like ceramic double ended egg style but there are many types); guy rope, preferable UV resistant, but almost anything can work, including weed-wacker line, fishing line, rope, and of course wire - just make sure it cannot come near the antenna wire; pulleys; baluns - 1:1, 4:1, 9:1; 450-ohm ladderline; wire for radials (buy a spool od 14 gauge wire unless there is a need for other sizes; keep an eye out for things which can work as supports and things that can work as strain-relief at feedline connections; ferrite beads, ferrite toroids, 4"PVC pipe sections or used coffee cans for coax RF chokes; antenna analyzer – nice, but not necessary . . . but nice!

Half-Wave Sloper

Slopers (also known as *half-wave slopers*) are a variation of the dipole antenna, and they have both horizontal and vertical polarization characteristics. While a 45° angle is common, they can be anything between 0 and 90 degrees. When they are straight up and down (90°) they are sometimes referred to as a *Halfwave Vertical Dipole* (HVD).



"Slipole" or "sloper."

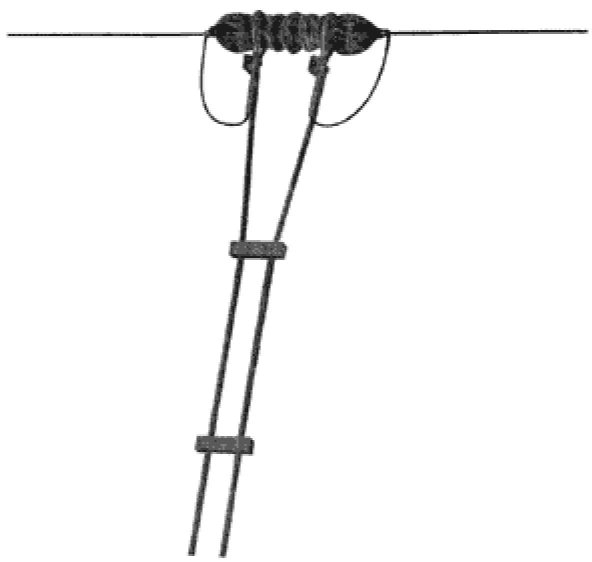
This configuration can be very useful when you have less than the ideal amount of horizontal space for a flat-top antenna, or when you wish to use a single support, such as a tree or mast, for the antenna. (If the antenna is going to be used where people are likely to be, make sure the lowest end of the antenna is high enough off the ground to avoid physical contact with the radiator.) Assuming you are feeding the sloper in the center, you will want to make sure the feedline does not become part of the radiating element of the antenna since it is near the ground. Two things can help with this: first, make sure you have the feedline at a perpendicular angle to the radiating elements, at least 30-40° or more; second, add a common mode choke at the feedpoint with either ferrite beads or a coaxial loop. Some folks add a second choke about ¼ wavelength down the feedline as well, and this certainly can't hurt.

Like any antenna the half-wave sloper is a compromise antenna, with its vertical characteristics adding to the noise you are likely to hear. However, its savings in size, use of one tall support, and ease of construction may outweigh its disadvantages, especially in the lower bands. If you happen to live where noise is not as big of an issue as city-dwellers, this antenna can be a real boon.

Slopers show a bit of directionality in the direction of the slope, with slight front-to-back signal ratios, and they offer decent low take-off angles for DX work. While not the first choice for DX work, they can be good antennas for some situations. Even if you already have another antenna you may want to try a sloper just for the experience. A friend of mine has a 160 meter sloper coming off his tower running back into the woods and he uses it both for 160 work and for medium wave broadcast listening. It's a great antenna for AM listening!

Center-Fed Multi-band Antennas

Like a center-fed mono-band dipole antenna, a multi-band antenna of similar design is one of the simplest antennas to build, and one of the least expensive. The symmetry between the two radiating sections allows for a balanced current, and when using an open-wire feedline losses are minimized. Assuming a flat-top design and a feedline running away at a right angle to the antenna for at least a quarter wavelength, the feedline current should remain balanced.



The antenna length can be anywhere from ¼ wavelength to ½ wavelength and operate successfully, but shoot for ½ wavelength if possible for best results. Because the antenna is designed to work with multiple bands you will want to use a tuner. Some tuners accept open-wire directly, while others will require a balun to transform it to a coaxial line input.

As long as the feedline is kept away from the ground or other conducting materials, its length can be pretty much whatever you need. A common size multi-band antenna is the 135’ 80-10 meter dipole antenna. This antenna can be hung completely flat (horizontal), or as an inverted “V” configuration. While the feed point height is not absolutely critical, 50’ is considered good for this antenna if possible, although almost anything over 32’ will work well.

Use whatever is convenient for the supports, whether trees, masts, or buildings. Just make sure to keep the feedline clear of metal and/or bends on the way to the transmitter. While a horizontal configuration is ideal, an inverted “V” shape can give very good results, and it represents a good savings in the space required for the antenna.
In general the horizontal configuration will work best on the upper bands, while the inverted “V” will do its best work on the lower bands.

G5RV

The venerable G5RV is a very popular form of multi-band antenna, available commercially or easily made at home with designs being plentiful on the Internet. The main draw of this antenna is its ability to be used with an antenna tuner on 80 thru 10 meters, including some band harmonics with a wide-range tuner. The antenna is usually 102’ in width, with about a 32’ ladder line feedline which can then be converted to coax as needed to connect to the transmitter. Some folks use a balun to make the conversion to coax, but the antenna will work well hardwired to the coax as long as you add a common-mode choke near the coax junction to prevent RF traveling down the coax into the shack.

While some folks complain that the antenna is not resonant on any band, I like the antenna for its versatility. It was my first HF antenna, and I still use it on a secondary rig with great results. The antenna is best on 20 meters, but with a tuner it will give very good results on 40 meters and decent coverage on 80 (with some bandwidth limitations). There is also available a “super” or “double” G5RV which will add some coverage on 160, and will increase bandwidth on 80 meters. This antenna is 204’ long, with a 64’ feedline section which must be fully extended. This means the antenna height must be above this distance, usually around 70’ or above.

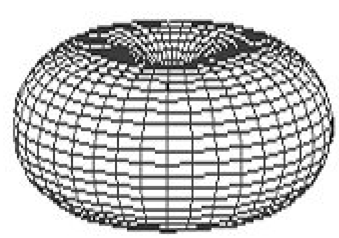
The 44’ Doublet

One final multi-band wire antenna I need to mention is one suggested by L. B. Cebik, W4RNL (SK), one of the modern “masters” when it comes to all things antenna. In testing various multi-band antenna designs and concepts, he discovered an interesting thing: where you might assume a longer antenna would be better (say, 1.25 wavelength or greater), a shorter version of a 40-10 meter antenna actually works better. He found that a 44’ dipole worked quite well on the required bands, and of course had the added benefit of taking up less room than a full ½ wavelength dipole for the same bands.

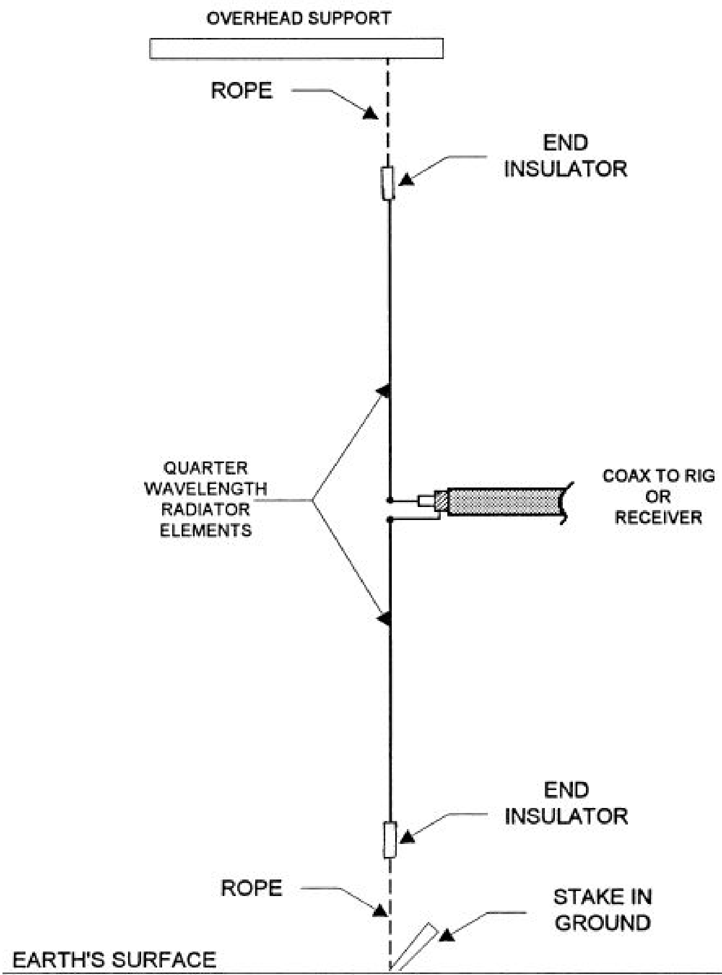
Vertical Wire Antennas
Just Different!

First, let me dispel some vertical antenna myths. Vertical antennas are not inferior to horizontal antennas, they are merely different. Vertical wires radiate signals just like their horizontal counterparts. The difference is in the orientation of the antenna and the effects of that orientation as it relates to radiation patterns and the surrounding ground around the antenna.

In fact, one of the interesting things about a ½ wave vertical dipole antenna (HVD) is that it becomes almost a true omni-directional antenna because of its vertical orientation. As you may recall from my discussions of horizontal dipoles, they radiate from the sides of the wire and not the ends. The same is true for a vertical dipole. However, since the antenna is vertical, the radiation pattern goes outward as displayed in the graphic at right.



Another bonus is of course the real estate savings over a horizontal dipole – a vertical dipole takes up very little space, and this can be a real factor in urban settings.

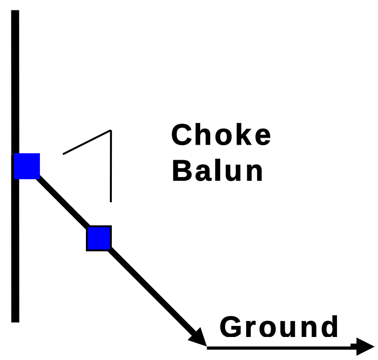


As an aside, in terms of comparison to more common vertical designs, computer modeling shows about a 1.5 dB gain for a HVD over a typical quarter-wave dipole because it is stronger out to the horizon. If you can erect a true half-wave dipole it is definitely worth it!

Of course, a real HVD requires a lot of height to not only cover the half-wave length of wire, but also it needs to be 6-8’ off the ground if it is not to be in the way people walking in the area. This can sometimes be hard to achieve. Another issue for vertical antennas is what to do with the feedline. Most situations require that the feedline be run perpendicular to the antenna for a moderate distance to avoid impedance issues, and here’s why:

Because we are dealing with a dipole, if the feedline (even coax) runs parallel to one arm of the dipole, RF current traveling down the coax will interfere with the radiation pattern/effectiveness of the dipole. By pulling the feedline away and adding a choke balun, the interference is minimal.

One solution is to run the coax down at about a 30° angle with ferrite beads clamped at the feedpoint and again about ¼ wavelength down the coax to the ground. This should eliminate virtually all the RF from coming into the shack.



Low Take-Off Angles
Vertical antennas have another bonus by their design/orientation, and that is improved take-off angles for working more distant stations. Horizontal dipoles in general have higher take-off angles which reduces the distance the signal can travel before being reflected back down to earth. With a low take-off angle the signal will rise more gradually and go further before being reflected back to earth. This can be really advantageous when you are hunting DX!

Quarter-wave Vertical
The more common vertical antenna is the quarter-wave vertical (or 5/8's wave vertical) which is often made out of aluminum tubing for the above ground section, with wire radials for the counterpoise. But this antenna can easily be made completely with wire—you just need something from which to hang the wire at the top of the antenna.

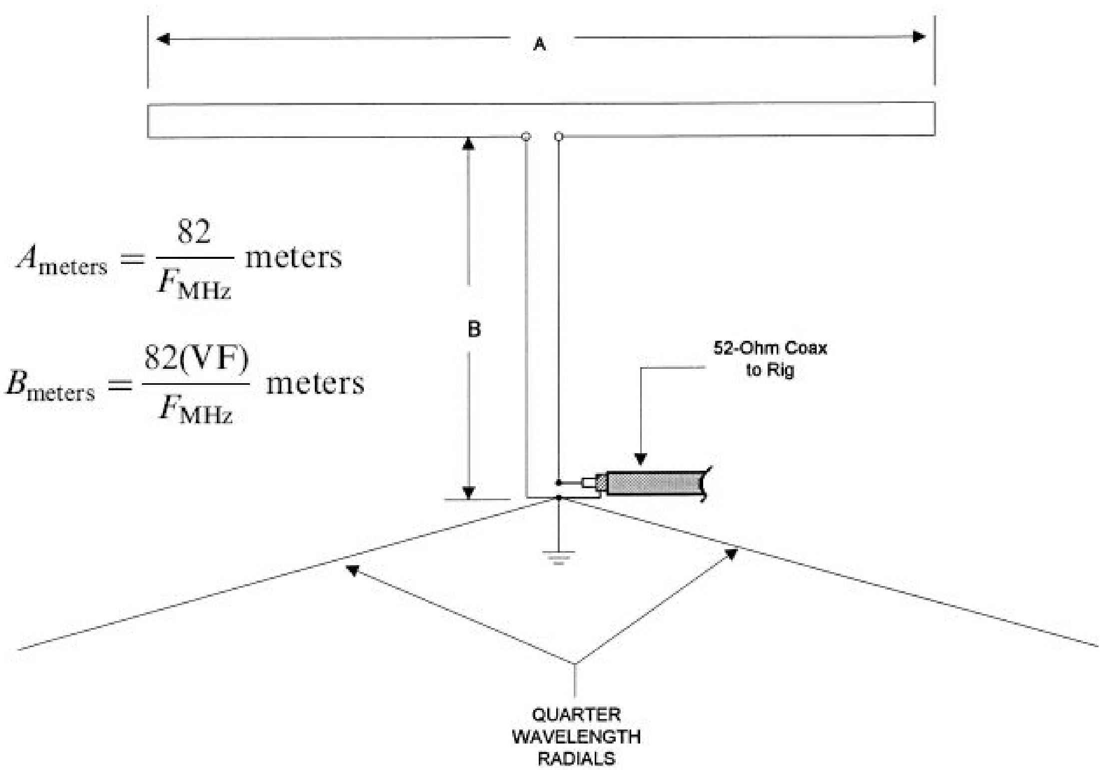
Just by way of review, the radials should be at least 4 in number, with more being useful up to 16 or so. As for length, the longest ones should approach ¼ wavelength (basically matching the vertical element) if possible; 1/8 wavelength will work also, or whatever your space can afford. There is little to be gained by making the radials longer than ¼ wavelength, so don't worry about that. If you can't make the radials all the same length, do the best you can.

When checking your antenna for resonance on the band(s) you want to use, make adjustments to the height of the antenna and to the radial length/number of radials to see what difference the adjustments make. Do one thing at a time, however, so that the results don't get muddled. For example, raising the antenna higher off the ground will have a significant impact up to about ¼ wavelength, less as you go up from there.

The same thing with adjusting the length of your radials—try to keep them in proportion (multiples) to the vertical element—1/4 wavelength, 1/8 wavelength, 1/16 wavelength etc. If using 8 or more radials on a multi-band vertical, cut half of the radials to ¼ wavelength of the lowest band (e.g 40 meters), and half to the second lowest band (e.g. 20 meters). This will give you improved performance on several bands.

Folded Marconi Tee

The Folded Marconi Tee is a basic yet interesting design which can be made from ladder line. I found this antenna in one of Joe Carr's books, and I liked it for its relative simplicity. This antenna does require a set of ¼ wavelength radials for proper operation, as indicated in the diagram below, and so it may not be suitable for you if space is tight. One of the advantages of this antenna, however, is that it does work well for frequencies below 40 meters since it requires less space than a standard dipole for the same frequency.



$$A_{\text{meters}} = \frac{82}{F_{\text{MHz}}} \text{ meters}$$

$$B_{\text{meters}} = \frac{82(\text{VF})}{F_{\text{MHz}}} \text{ meters}$$

Use 300 or 450 Ohm twin-lead wire, cut to the approximate length needed for the band you want to use (remembering to leave it a bit long to trim down as needed!). There are two main sections of wire, A and B, both relatively the same length. The difference between them is that B is shortened a bit based on the velocity factor of the twin-lead being used. A suggested starting point is a velocity factor of .82 for 300 Ohm wire.

For example, to make an 80 meter antenna with a resonance of 3.8 MHz, one would divide 82 by 3.8 to get 21.75 meters (or 269’ divided by 3.8 = 71’); thus A= 21.75m and B=(21.75 x .82)= 17.8m (or 58.5’).

Now that you have determined the lengths for A and B, find the center point of A and clip one of the two twin leads to allow for both B conductors to be attached to it at a 90° angle as indicated in the illustration. A is the horizontal section of the antenna, while B is the vertical section. You may have noticed that A and B form a loop, with one lead of B connected to the outer shield of coax and the other to the center wire.

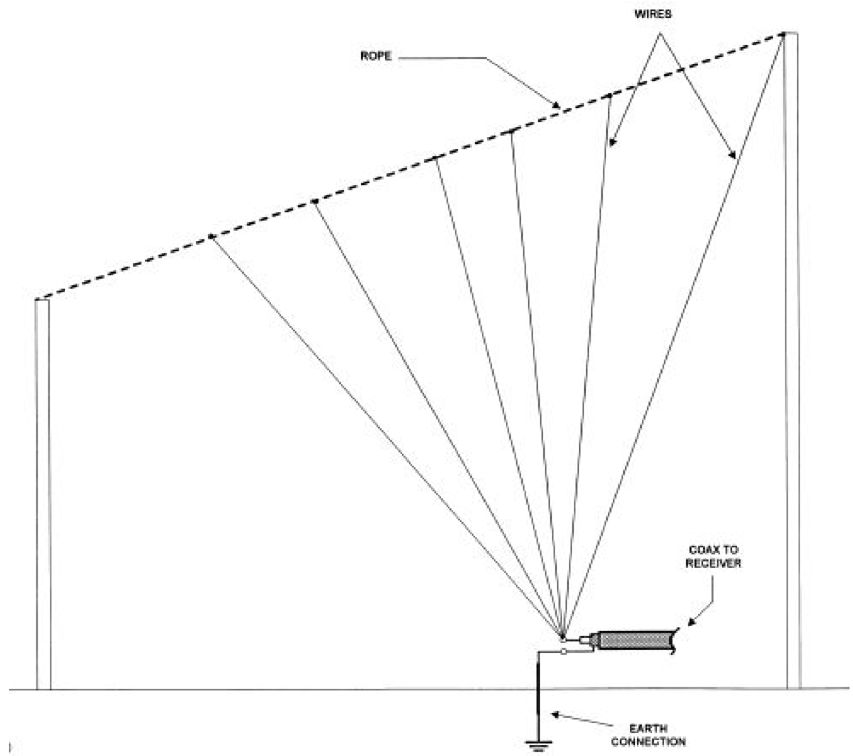
One end of length B is connected to A as shown, and the other end goes to ground/radials and the radio/tuner as indicated. Each end of length A should be shorted together (similar to a folded dipole). Attach support ropes/insulators and tie off each end to a mast or tree or similar support.

This really is a simple wire antenna to build as long as you follow the usual rules for working with twin-lead wire, meaning that it cannot come into contact with metal surfaces or run along the ground, or have any bends in it. This would be a relatively easy antenna to make as a portable antenna if care was taken in rolling up the antenna and the radials. The Ropes could be strung along any convenient surface as long as you had a means of getting them up into the trees. Maybe an interesting field day antenna?!

The Swallow-Tail Antenna

Another antenna from Joe's book "Antenna Toolkit" that I have not seen elsewhere but which looks very interesting is the Swallow-Tail antenna, so-name for its tail-like shape of multiple radiating elements.

This is a multi-band antenna, with each band represented by a radiating element cut to ¼ wave-length for resonance. The only real limitation in terms of wires is to make sure you avoid any third harmonic wires (so for example you could have wires cut for 40 and 20 meters, but not 15 meters.) The good side of this is that the antenna wire will be resonant on the third harmonic anyway, so a separate wire isn't necessary.

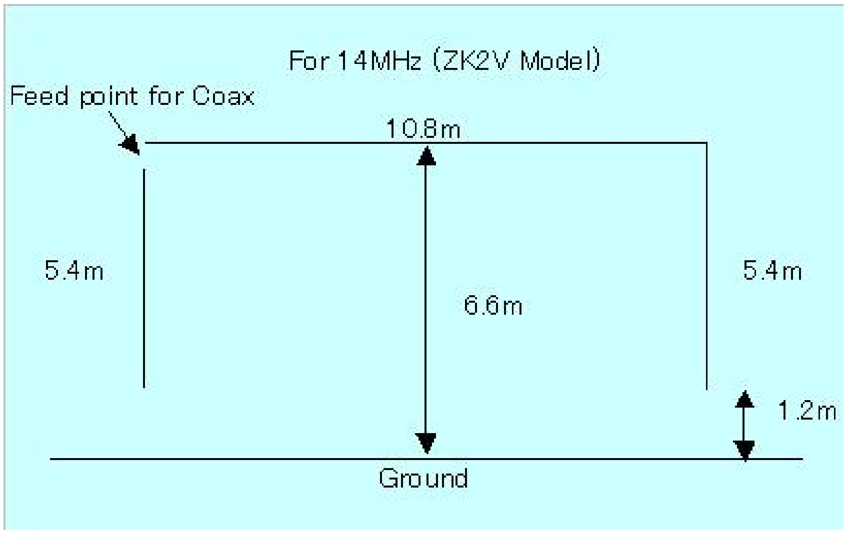


Like the Folded Marconi above, a good ground is needed as indicated in the illustration, but unlike the Marconi Tee, no ground radials are needed. String a rope between two support structures and attach the wires evenly spaced along the rope and mount it with sufficient height to clear the ground by 6-8' so as not to present an obstruction for folks walking in the yard. The ground system should be at minimum a metal stake driven 6-8' into the ground. While radials aren't technically necessary, you could try adding radials if you have the room to see the effect just for the fun of it—it might turn out to be a nice variation.

Half-Square Antenna

Here's an antenna that has several likeable features: 1) it's simple to build and erect; 2) The horizontal feeline supports the vertical radiating elements (vertically polarized); 3) It's unbalanced by design and can be fed straight to coax.

The antenna is referred to as a vertical 2 element phased array, meaning there are 2 vertical elements working in phase to radiate the RF signal. A common example is given here, although there are numerous variations depending on band(s) and space requirements.



The coax is fed as indicated, with the center wire connecting to the long feedline/ vertical, and the shield connecting to the other vertical. You may want to devise a means of strain relief for the coax corner, or some form of insulator. The typical design calls for ¼λ (wavelength) for the two vertical elements, and 1/2λ for the horizontal element. I have seen some designs where the ends of the vertical are folded in the help resonate the antenna, but this is entirely up to you. I prefer just folding the wire back on itself to create the termination point, just in case I need to add to the length a bit down the road. However, if space is tight and you can’t quite fit the full vertical length, the ends may be folded in ata right angle with out must loss since the current point is at the high end of the antenna.

The antenna may also be fed from the low end of one of the verticals (making it a high impedance voltage feed) by connecting the center wire to the vertical and the shield to a short ground counterpoise. The advantage to feeding as shown is that the impedance is quite low, typically near 50 Ohms, just right for feeding a transmitter.

The antenna has a pretty significant gain, upwards of 3-4 dB or more, and its simplicity makes it very attractive. Another option with the antenna is to double it by adding a third vertical element and a second 1/2λ to the horizontal feedline. The full wavelength horizontal wire can require quite a bit more space, as well as a third support for the additional vertical element. But if you have the space it can raise the gain even more.

Antenna guru Rudy Severns (N6LF) published an article (Antenna Compendium Vol. 5 1996) on expanding the bandwidth of a half-square antenna by adding another vertical element on each end, forming an inverted “V” on the ends. The two wires are slightly different lengths (1/4λ - ~10%), with different resonant points which broaden the antenna.