The antenna

This 10 - 160 meter tuned horizontal loop antenna is fed with 450 ohm ladder line all the way into the ham shack to an Palstar AT1500BAL balanced line antenna tuner. The above graphic depicts the overall layout of the loop antenna consisting of 558 ft. of #16 "silky" stranded wire cut to one wavelength long on the lowest operating frequency (160 meters). The mean height of the loop above ground is about 55 ft. The loop is suspended from from four corners by nylon halyard strong over the top of 4 adjacent trees as shown above.

- Side A is 40 ft
- Side B is 208 ft
- Side C is 55 ft
- Side D is 255 ft
- Side E consists of about 65 ft of 450 ohm ladder line running from the tuner in the shack to the antennas feed point which is about 55 ft above ground level.

Note: Click 80 meter loop for a sketch of a similarly constructed 10 - 80 meter delta loop that has sometimes been in operation.

A - Method used to bring 450 ohm feed line into the shack consisting of a painted 1 x 6 board cut to the window's width. The feed line passes through a slot. Clear silicon sealant was used throughout.

B - One of four corner loop suspension points consisting of nylon pulley attached to nylon halyard.

C - Loop antenna feed point. 'Silky' 16 AWG, 19 strand, tinned, 40% copper-clad steel forms the loop itself and 450 ohm, 16AWG, 19 strand copper-clad steel conductors, poly-clad "window" is used as the feed line.

Why choose a loop antenna?

Loops are usually cut a full wavelength long on the lowest expected operating frequency. The formula for a full wave loop antenna is Length (feet) = 1005/f MHz. For example, a loop for the frequency of 3.800 MHz would be calculated as follows: 1005/3.8 = 264 feet.

A multi-band loop antenna offers significant advantages especially for hams who prefer to only use one wire antenna for all bands:

- A loop is quite forgiving and perfect symmetry is not essential. Ideally the loop should be be in a configuration providing the greatest enclosed area at the highest height possible. Since the loop can be erected in unusual places and still perform well, treetop suspension is often used. I rely on heavy duty nylon or black dacron halyards with nylon pulleys at each attachment point to keep equal strain on each leg of the loop. A slingshot, fishing line and heavy sinker get the halyards up and over the trees as necessary.
- Unlike a center fed dipole, the loop can be fed at any convenient point.
- Since the design of a loop is typically a square or delta form, the need for a long straight run of wire such as a dipole is diminished.
- A loop makes for an efficient broadband radiator, even when low to the ground or close to obstructions such as tree limbs. The majority of the amateur bands are harmonically related, typically the 1st harmonic. A loop is easily tuned to resonance on all harmonics of its fundamental frequency. A dipole by contrast is easily tuned to resonance only on its odd harmonics. A loop starts out with 1.2 dB of gain over a dipole on its fundamental frequency.
- A loop's gain over a resonant dipole increases with the increasing frequency of operation. Therefore, when used on its harmonics, a loop's signal advantage over a dipole likewise increases. At higher bands, radiation angle is lowered resulting in improved DX performance.
- The venerable loop is easy for a balanced line capable tuner to match on all bands when fed with 300 or 450 ohm balanced feed lines.
- Although I'm not convinced, most hams who use loops often claim that a loop is less susceptible to atmospheric and man-made noise.
- Ladder line fed loops significantly reduce the chances of rfi in the shack. The antenna does not rely on the need for a good RF ground to the same extent as unbalanced coax fed dipoles or loops. There is widespread misconception on this point. More about this below...

Many hams find it difficult to bring ladder line all the way into the shack to the tuner and resort to the use of remotely located coax fed balun (usually 4:1) connected to the ladder line. I have tried this approach and found that it usually works better on some bands than others. My recommendation is to avoid this technique if at all possible. Finally, try to use a tuner design that has been optimized for this type of antenna.

You too may want to consider the time-honored loop. It is simple and inexpensive to homebrew and can yield surprisingly effective performance. All things considered, it's a great multi-band antenna.

visit http://www.cebik.com for a theoretical examination of the effectiveness of large loop antennas.

Why feed the loop with balanced line?

If you doubt the viability of feeding wire antennas like loops and dipoles with open wire line, read the following explanation courtesy of K5UA "Charles":

There are two kinds of line loss, the matched line loss and the mismatch line loss. Matched line loss is measured at different frequencies in db per 100 feet when the line is terminated into a load which is identical to the characteristic impedance of the line. The loss increases as the frequency increases.Mismatched line loss is an additional attenuation of the signal because of the line being terminated into a load which is different than the characteristic impedance of the line. This loss increases with frequency, but it also increases with the magnitude of the mismatch. Needless to say, lossy lines like the small coax have higher mismatched line loss numbers for the same amount of mismatch than the lower loss, large coax lines.

Matched line loss is unavoidable, but mismatched line loss is avoidable if the load can be matched to the line at the load end of the line. An example of this would be a gamma match at the yagi terminals to transform the 16 ohm impedance of the antenna to the 50 ohm characteristic impedance of the coax. Another example would be to use a 4:1 Balun at the antenna terminals to bring the 16 ohms closer to 50 ohms.

The match can also occur at the transmitter end of the line, but the mismatched line loss would be there. The transmitter would be happy looking into a 50 ohm load, but the mismatched line loss would still be present because the load is not matched.

The beauty of open wire line is that the matched line loss is virtually zero. Even with large line/load mismatches, like 10:1 or 15:1, the additional mismatched line loss is very low. As long as the user has a conjugate match on the transmitter end of line using an antenna matching network, virtually ALL power is radiated by the antenna. Power can not disappear, it is either radiated or lost in the line by attenuation of the dielectric material between the transmission line wires. This is why a random wire of reasonable length may actually radiate MORE power when fed
by open-wire line through a tuner, than a perfectly matched half-wave dipole fed with small coax, assuming the feed line length of each is over 100 feet.

The net effect of this is that you can put up a random length dipole (or a loop as discussed here) and use it on all bands with very little line loss and not have to worry about a bunch or resonant dipoles interfering with each other.