LOOP SKYWIRE ANTENNA

Design

When I bought my house this spring, I immediately started planning an HF antenna for my ham radio station. It's been several years since I last had a permanent base station set up and I wanted to get on the air. After evaluating my options, I decided that a loop antenna would be my best option. The biggest advantage for me is that a large loop antenna fed with ladder line allows for good performance on a wide range of frequencies using a single antenna. This design also allows me to maximize the amount of antenna that I can fit on my 1/2 acre lot (an 80 meter loop is only 72ft on a side vs the 135ft overall length of an 80 meter dipole) without having to put up masts or towers.

The general idea of a loop skywire is to put up as much wire as possible, without worrying about cutting it to resonance, and feed it with ladder line. Since ladder line exhibits very low loss compared to coaxial cable, even with a large impedance mismatch, the total amount of signal loss in the ladder line will be minimal. With a good antenna tuner between the ladder line and the radio, all of the HF ham bands should be available.

Components

For wire I purchased Wireman #531, which is insulated wire made up of stranded 13 AWG copper-clad steel. The steel core makes it strong (400 lb breaking strength) and helps minimize stretch, while the copper cladding gives it good electrical conductivity. The insulation helps to protect the wire from the weather.

The feedline I chose is 300 ohm ladder line, which is a little harder to find than its 450 ohm cousin. Some ladder line is cheaply made, but this type from DX Engineering uses 18 AWG copper-clad steel and works very well. They also make a great antenna feed point kit with built in strain relief slots for use with their 300 ohm ladder line. It is well worth the money.

While I could have used a balanced tuner, or some other type of manual antenna tuner, I decided to go with an automatic antenna tuner for my station due to their ease of use and their ability to store impedance matches to memory. The memories allow the tuner to pull up previous tuning settings without having to rematch the radio to the antenna, saving a lot of time.

I use a LDG AT-200ProII in my station and it has worked great so far with my loop antenna. I chose this model for its wide impedance matching range, its ability to store 4000 frequency & impedance combinations, and its 200 Watt power rating. Although I don't plan on using more than 100 Watts in my station, the 200 Watt model is only slightly more expensive and because of its higher power rating it will hopefully be even better equipped to withstand the high impedance mismatches that this antenna presents.

The final piece of this arrangement is the balun. In this case I used a high power current balun between the ladder line and the antenna tuner. This device blocks the current on one side of the ladder line from continuing on to the shield of the coax on the other side. In this way it transforms the balanced load of the antenna and feedline into an unbalanced load for use with the antenna tuner and radio. I could have made my own balun, but I decided to buy a DX Engineering BAL050-H10-AT. This is heavy-duty (rated for 10KW) balun designed for exactly this type of application and is much better constructed than anything I could have made on my own.

Construction

Putting up the loop was a relatively straightforward process. The first step was to pick which trees to put the support ropes in. I don't have a ton of options on my small lot, but four trees were spaced appropriately for me to make a trapezoidal shaped loop. To get the ropes (I used 3/16" Dacron) into the trees I used some light nylon cord tied to a wrench and tossed the wrench over the highest branch I could reach. I then pulled the heavier rope up over the branch. Next I attached the insulators that I had made using 1 inch 45 degree PVC elbows (painted black for stealth) and bungie cords. The bungies act as a stress relief between the trees and the antenna, thereby allowing the trees to move in the wind without jerking the antenna too hard. I used bungies on three of the four corners, leaving only the corner nearest the feed point without one.

I then ran the antenna wire through the insulators until I had both ends at the location of the feed point. By taking the slack out of the ropes I was able to start trimming the antenna wire such that when the insulators were lifted as high as I could get them the antenna wire was tight. After a few adjustments, and some branch trimming, I was able to get the antenna in the air.

I then set the antenna back down and attached the ladder line to the feed point and raised the antenna to its final position.

Finally I mounted the balun to the side of the house and ran the ladder line to the balun. To support the ladder line I attached some rope to the feedline with zip ties and hoisted it using an eyebolt screwed into the eave of the house. I also made a spacer/strain relief for the ladder line to keep it away from the aluminum siding on my house. This is necessary because if ladder line is too close to anything conductive it can unbalance the feedline, thereby causing it to radiate like the antenna.

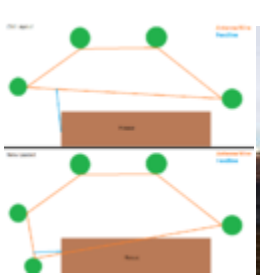
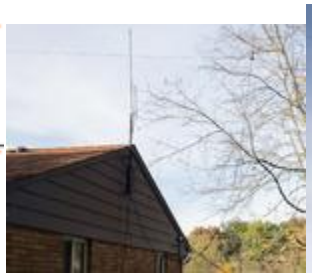
Performance

After trimming, my loop ended up being 215 feet in circumference and uses 47 feet of ladder line. I lucked out on the length of ladder line that I needed; you have to be careful not to use a length that is harmonically resonant on any of the frequencies you wish to operate, otherwise the feedline could radiate and cause interference.

While this antenna is technically a little short for use on the 80 meter band, it will tune on that band along with all of the remaining HF ham bands (except 160 meters).

Considering the limitations of my property in terms of the size and height (around 30 feet) of the antenna, I couldn't be happier with it so far. I love the ability to operate from 3.5 to 30 MHz without having to switch antennas. Overall performance has been great. In my limited time using my new station I have been able to contact stations in Europe and throughout the US, as well as have a lot of fun in the Pennsylvania QSO Party (my home state) where I was able to contact pretty much every station that I could hear.

After reevaluating the trees in my yard I realized that I could rework the layout of my loop skywire antenna. This would allow me increase the size of the loop, improve the feed point arrangement, and increase the height of the antenna.


After adding a fifth anchor point the loop is now a distorted pentagon instead of trapezoidal in shape (see the sketch for the rough layouts).

The new arrangement is not only larger, but also higher than before, which should help its performance. With a new circumference of approximately 244 feet of wire the loop is much closer to resonance on the 80 meter band than it was previously. Due to the repositioning of the feed point I had to shorten the feedline. I decided on 37 feet of 300 Ohm ladder line as an acceptable non-resonant length for the feedline. This is a good length since it keeps it well off the ground while still providing some slack for movement. So far the performance has been at least as good as the previous version.

Source: http://www.highonsolder.com/blog/2012/10/26/loop-skywire-antenna.html