THE ITINERANT 160 METER ANTENNA PROJECT

The plan is to develop a simple, relatively inexpensive, relatively light weight and shippable/airline transportable 160 antenna kit for one man quick deployment for modest DXpeditions or contributed for use by resident hams in rare-ish (for 160 m) locations. The ability to make adjustments to actual deployments to provide matching is important since such antennas are famously variable due to soil and local obstruction environment and there should not be a need for antenna matching hardware, especially at the planned higher powers.

> *The components will have a minimum length of 6' due to the aluminum tubes. If the tubes are telescoped down, the linear dimensions of the packed tubes alone would be about 80" which is the maximum size (largest oversize) allowed on some flights.*

First cut electrical design: Inverted L using telescoping aluminum tubes, two elevated radials and "hairpin" matching.

> *Of course Inv L is less than ideal due to high angle radiation but it is simple. Alternatives might use different top loading with 2 (T), 3 or even 4 (umbrella) top wires symmetrically placed. But then we get more wire, space and complexity. Elevated radials (in use at N6MW) can provide decent performance with a minimum of wire and nothing to trip over. IF there is a lot of space, you could go with standard ground radials, perhaps using cheap aluminum electric fence wire. Matching with a tapped coil that could add some inductance to the antenna and allows adjustment of the "hairpin" would be simple and flexible given you adjust the length of the top wire and maybe the radials as well.*

Mechanical features of a prototype that was deployed:

9 Alum tubes 6', .058" walls, 2" diameter through 1" diameter – this gives a 50' or 15.3 m mast (it can be pulled upright by 1 person, or probably telescoped up also)

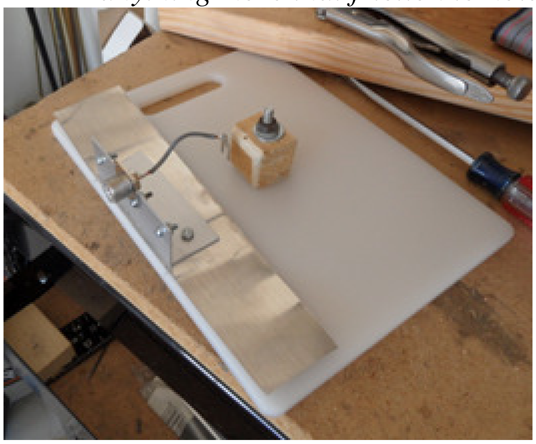
> *The 9 tube mast with guys at the 7 tube height is pretty stable in moderate winds. You could add another tube (either end) but at some point another guy may be needed and the raising (or telescoping if no tubes are bent) will be come more difficult but probably doable. One could experiment with an additional tube.*

#14 wire ~ 28 m for top wire and 2X ~34 m radials (values after some adjustment, not unique, some tradeoff between the top and radials)

> *The prototype uses #14 insulated wired found cheap on eBay at .08$/ft. This is to not as flexible as you might like but it is tolerable. Maybe no smaller wire would be sufficient but one could try #16 which would help a bit with weight and flexibility. Obviously wire breakage at the top would not be good so a suitable attachment design is needed.*

Base - 2 thicknesses of Walmart (cheap 8X11") ¼" plastic cutting board resting on ground with a ~ 1.5" wood cylinder bolted in the center. SO-239 connector screwed to the board.

A half inch of cutting board seems fine for strength. One might want to somehow elevate it off the ground a bit to avoid rain collection/shorting problems. Additional aluminum strips/channel attached to the board can support the connector and provide connection points for the radials. The "cylinder" holds the bottom tube in place on the base – this works fine. No effort was made to use anything more that friction to hold the base in place and that was okay.



Guys – 4X 3/32" dacron rope attached at 7 tube height, angled at ~ 45deg

3/32" seems strong enough

Guys held down by sandbags (very effective and moveable)

Cheap and easy

Inv L top wire end was at ~ 2.5 m height with a support of opportunity (e.g., a tree) ~ 25 m from base

Worst case, the top wire could be attached to a sandbag on the ground.

Radials have their closest support near the base from plastic rings looped through each of an opposite pair of the guys at ~ 6 m high and 6 m from the mast. The radials therefore go from the base to the rings at about a 45 degree angle. (Elevating the base and everything else, by a meter did not seem to affect the impedance. Beyond that, supports of opportunity were used - above neck height is always nice.

This scheme with elevating the beginning of the radials with rings cut from PVC pipe works well aside from the fact that the wire slides through the ring when *tensioning the radial and this can put a lot of stress on the connector or just make it a pain to keep track of the wire. If it was properly measured out in advance, something could be attached to the wire to limit the outward sliding through the ring. Of course you will not have access to the height of the ring once the mast is raised.*

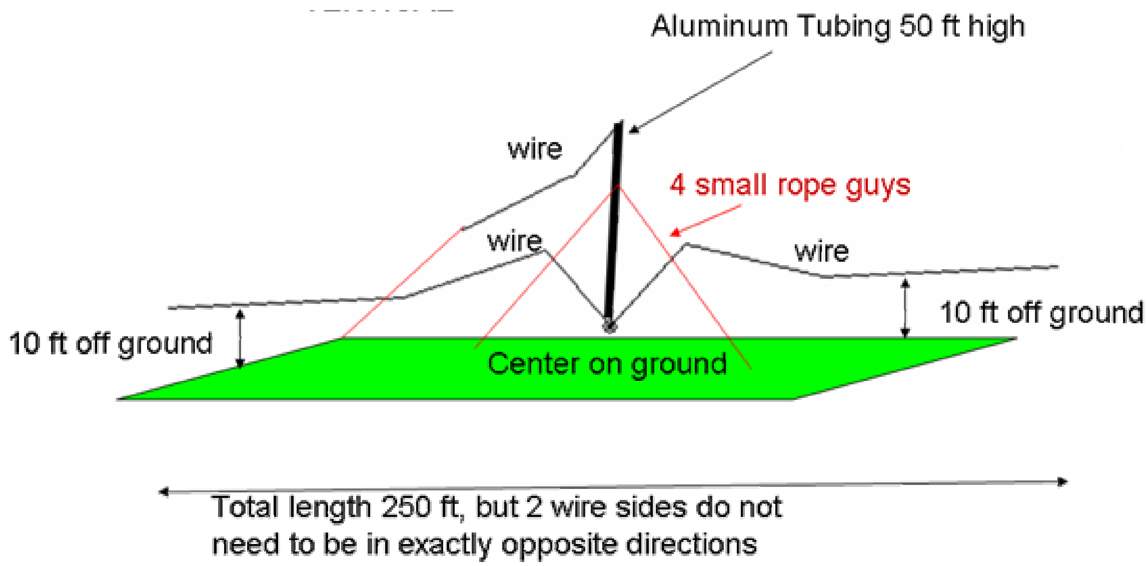
This produces, with some fiddling with wire lengths, an impedance around 20 – j20 which can be matched using a practical "hairpin" coil shunt of inductive reactance ~ 45 ohms (4 microHenrys, say 5 turns 4" dia).

It turned out that the initial wire lengths for the prototype, while cut long on purpose, were way too long compared with expectations from EZNEC leading to confusing very high impedances (300 ohms). After much cheerful testing and diagnostics the insulated wires were folded back a lot to arrive at the (equivalent no folding) lengths quoted above. Once that was resolved, it was fairly straightforward to shorten the top wire to get a capacitive reactance that can be matched by the "hairpin." Note that the resistive component of the reactance is rather larger than might be hoped (or provided by the model). Conventional wisdom is that this means the effective ground loss resistance is large. My 160 m antenna is similar to this Inv L with (somewhat better) elevated radials but with three top wires for the loading and the equivalent of 10 aluminum tubes. It shows about 9 ohms for the resistive component.

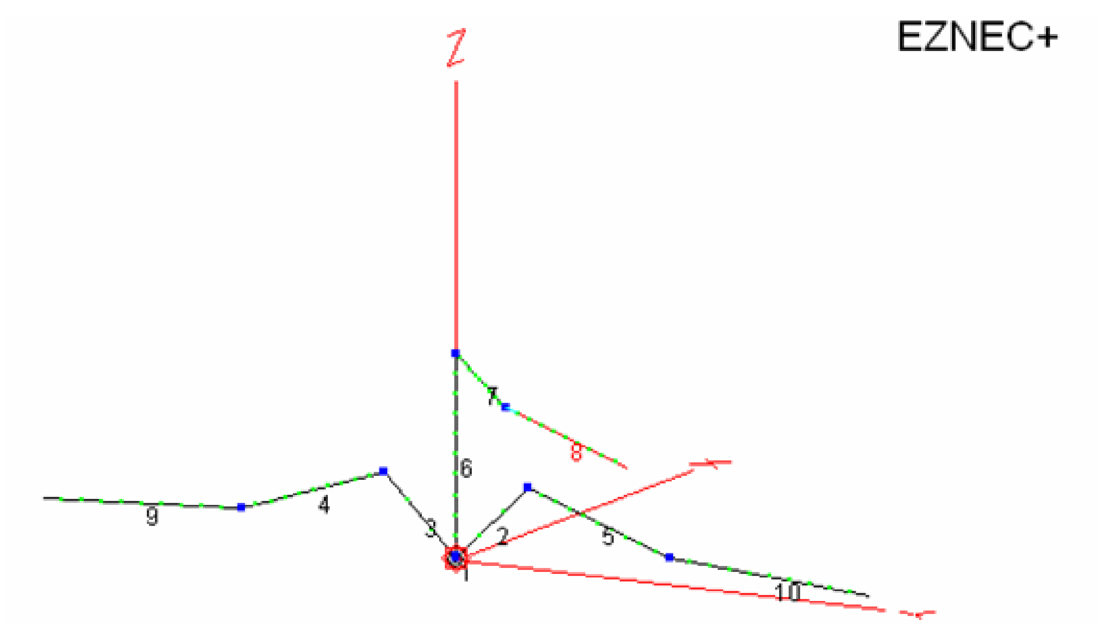
The standard hairpin match can be a coil with sufficiently stiff wire to be self-supporting. Compressing or lengthening the coil gives some tuning control. It probably would be wise to make the coils a few turns longer that nominal and then tap the coil (splitting the inductance between the parallel shunt and the series antenna. Some calculations will be needed to make sure the coil covers the range of potential raw impedances.

More details of the test case including the EZNEC example are shown on my website. There are obviously a number of ways this design could be modified/improved, several discussed on the website. However, the tradeoffs with size, weight and complexity must be considered in the light of the mission here which includes transportability and ease of deployment and tuning.

Here is a drawing intended for the non-expert just to show the general idea:



And the EZNEC graphic:



If anyone is interested, I can send a copy of the file.

I am looking for collaborators to contribute ideas to help improve, and potentially, test design issues.

Beyond that, perhaps there could be some collaboration on the actual assembly and distribution depending on interest. Please email me with any specific thoughts, beyond modeling.

The immediate target is designing and assembling a respectable 160 m antenna that might go to KH8 on a (so-far) fantasy DXpedition.

Have your ever thought to yourself – I could do a better DXpedition than that?

Bill, N6MW

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