Tech Talk May 11, 2025

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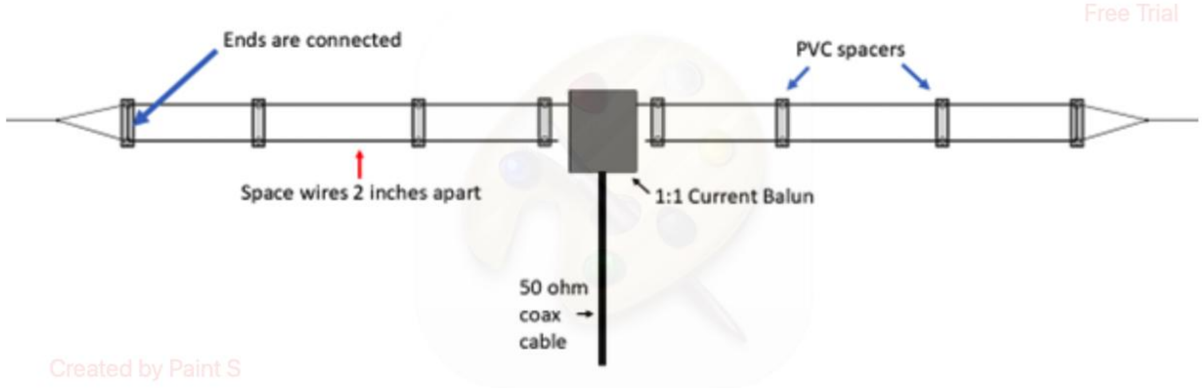

Figure 1 article picture

Article **https://www.onallbands.com/ham-radio-tech-linear-loading-long-wire-in-a-short-space/**

The article's questionable statements are:

1.) Linear loading results in a significant reduction in size while maintaining good electrical performance compared to its coil-loaded equivalent.

2.) According to the **ARRL Antenna Book**, linear loading introduces minimal loss and has a low Q, which allows reasonable bandwidth compared to using loading coils.

3.) Linear loading is superior to using an inductive coil because the loading is distributed along the entire length of the element rather than being lumped. The result is significantly improved radiation efficiency and a greater bandwidth than the coil-loaded equivalent.

4.) To explain how the linear-loaded dipole antenna works, let's look at the theory of resonant circuits and apply it to an antenna. Think of a dipole antenna as a pair of coils that have been stretched out to form straight wires, one on each side of the feedpoint.

5.) You may have heard that short ham antennas are not as efficient or effective as a full-length half-wave dipole, regardless of the configuration. Good news! Linear-load antennas are probably the next best thing, especially for those with restricted space.

Prove or disprove by Model of linear loaded antenna

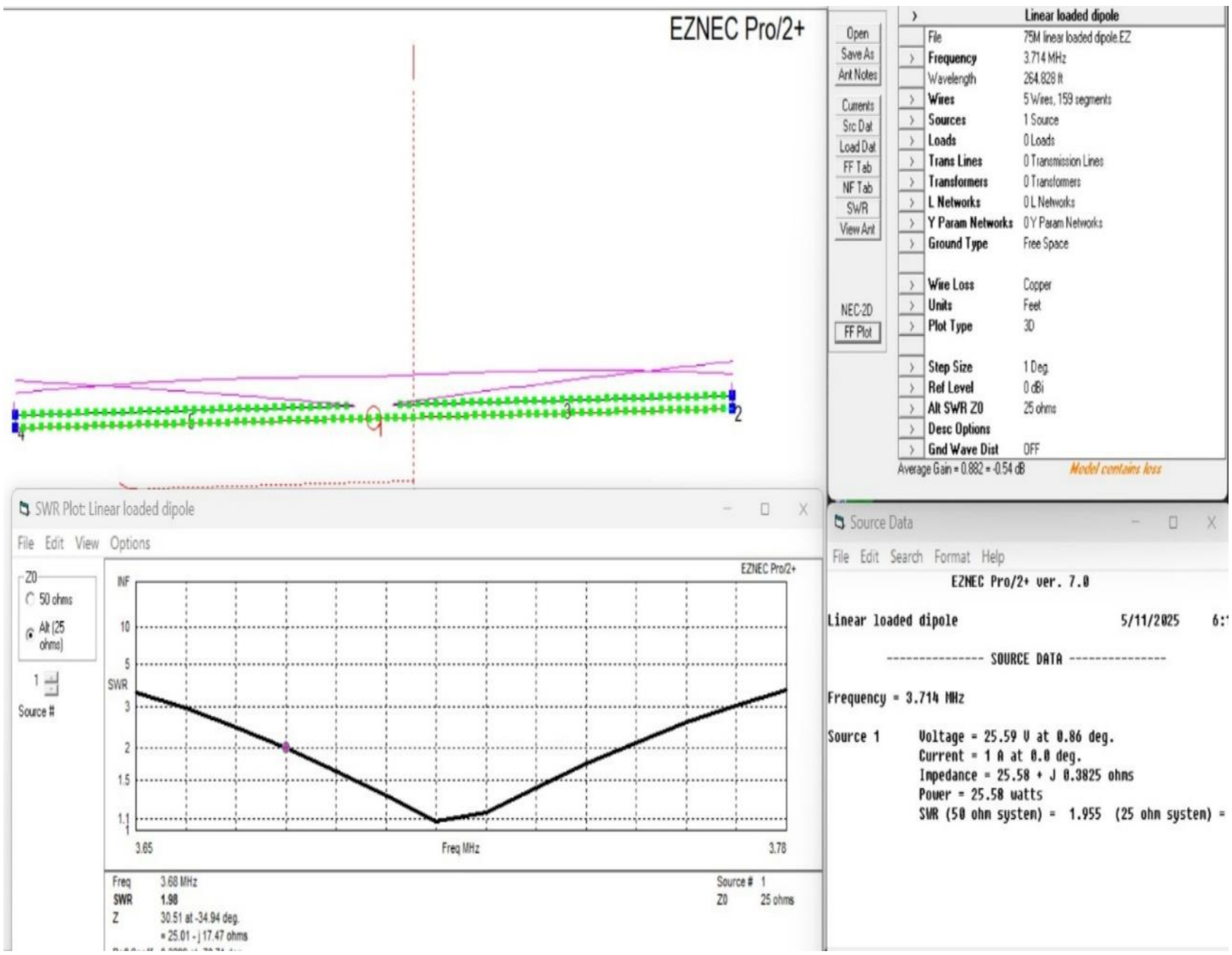

Figure 2 model of linear loaded dipole #14 bare copper wire (spaced one foot)

1.) BW 70 KHz @ 2:1 VSWR points
2.) Requires matching (25 ohms at resonance)
3.) Efficiency of 88.2% (free space)

Compare linear loading to a coil loaded dipole

Loading coils are an easily obtained modest Q of ~250. They could even be made as a trap, making the antenna 80 M and 40 M. In this case the loading coils are placed 20% back from the antenna ends. The antenna is the same length as the linear loaded

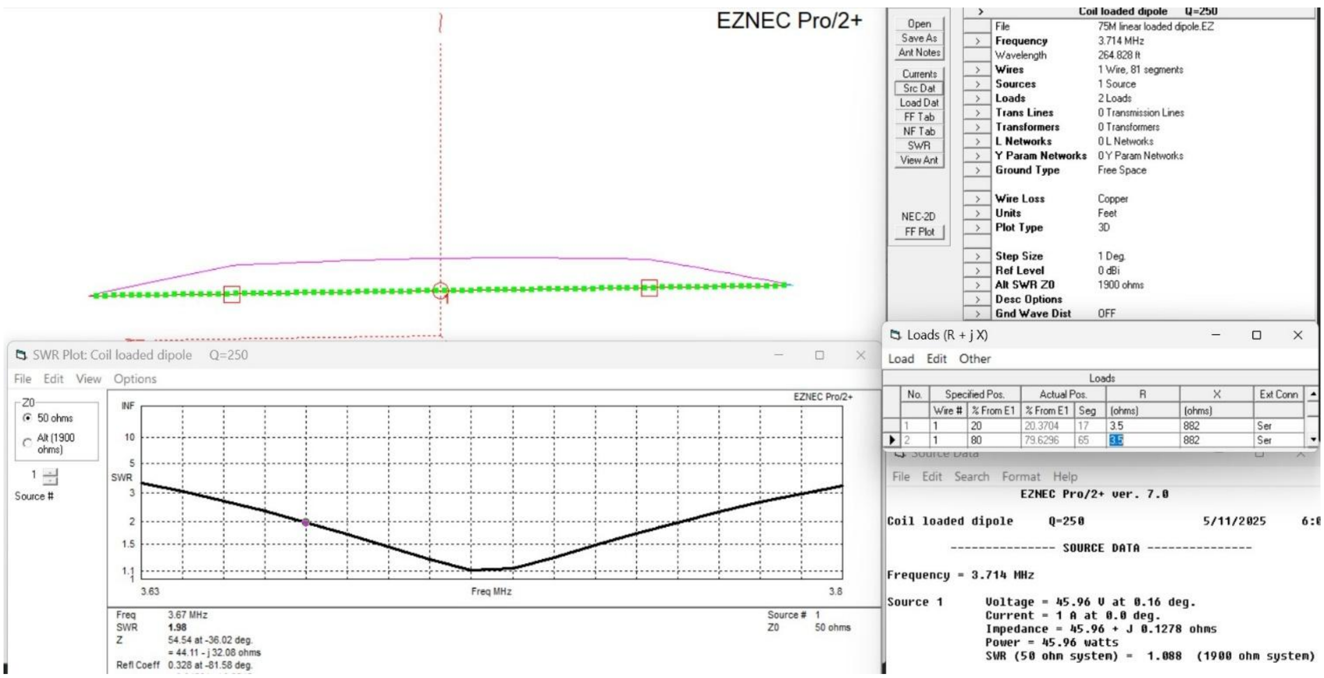

Figure 3 coil loaded dipole (same length and wire size)

antenna.

1.) BW 90 kHz @ 2:1 VSWR points
2.) Does not require matching (46 ohms at resonance)
3.) Efficiency 85% with modest Q loading coils

Statement Review

1.) Linear-loading results in a significant reduction in size while maintaining good electrical performance compared to its coil-loaded equivalent.

False, it is about the same. Loading coils can even be made better.

2.) According to the ARRL Antenna Book, linear loading introduces minimal loss and has a low Q, which allows reasonable bandwidth compared to using loading coils.

Not true. Loading system Q is often a very small part of bandwidth, in this case linear load bandwidth is less than the lumped loading coil example. A loading coil can also be less or similar loss without much effort.

3.) Linear loading is superior to using an inductive coil because the loading is distributed along the entire length of the element rather than being lumped. The result is significantly improved radiation efficiency and a greater bandwidth than the coil-loaded equivalent.

False, distributed loading is generally one of the worst ways to load an antenna. The best way is always adding capacitance at the open end and loading in a way that maintains the most uniform or constant current along the radiator's length. Linear or distributed load is contrary to that goal. We ideally want end loading by a capacitance hat, cage, or wire.

4.) To explain how the linear-loaded dipole antenna works, let's look at the theory of resonant circuits and apply it to an antenna. Think of a dipole antenna as a pair of coils that have been stretched out to form straight wires, one on each side of the feedpoint.

False, we cannot consider a dipole to be a pair of stretched out coils. The wire is a single wire transmission line that looks like an infinite number of small series inductances and shunt capacitors with electric fields fringing out into the space around the antenna

5.) You may have heard that short ham antennas are not as efficient or effective as a full-length half-wave dipole, regardless of the configuration. Good news! Linear-load antennas are probably the next best thing, especially for those with restricted space.

False, there is nothing special about linear loading. The best option would be dog legging or bending the open antenna end as little as possible, or using an end hat or cap. The second best would be adding a good lumped loading coil to that dogleg or hat system. One of the poorest methods is distributed loading like helical loading or folding a wire right back on itself. Linear loading is simple but not as good as other methods.

This example comparison table:

Antenna Style	Efficiency	2:1 SWR Bandwidth	Feedpoint Matching
Linear loaded	88%*	70kHz	Required (2:1 ratio)
Loading Coils (Q=250)	85%**	90KHz	Not required

***Note: If we add the required feed point matching system to the linear loaded antenna efficiency decreases a few percent. The efficiency difference is insignificant.**

****Note: In this example with no other changes, increasing loading coil Q to upper reasonable manufacturing Q limits of ~350 the coil loaded antenna has the same efficiency. It still maintains a wider bandwidth. To be sure, bandwidth scarcely changes with loading coil Q changes. Loading coil reactance and end termination capacitance has a much larger effect on bandwidth than inductor Q. The less reactance needed, the wider the bandwidth becomes.**

Summary

The ideal step order in fitting an antenna into a small area should be:

1.) Bend the antenna open ends the least amount possible. If that still does not work make a cage or hat at the open end.
2.) If a cage or hat still will not fit the antenna, add a loading coil(s) near the antenna's straight end(s) before reaching the bent end, cage, or hat. The goal is to use the smallest reactance possible and keep the reactance out near the antenna open end.
3.) Distributed loading is generally the worst loading. Properly placed lumped loading is the best, with a bent end or an open-end capacitance hat or cage as a first goal.
4.) The goal is always to maintain the most uniform current possible throughout linear space. Radiation resistance, gain, and efficiency is maximized when antenna current is most uniform across linear space occupied by the antenna.