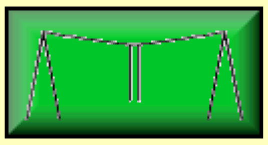

Not Everything Good is New:
Curtains for the Extended Lazy-H

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The Basic Expanded/Extended Lazy-H

A few years ago, I called attention to a wire array that receives notice only about every fifteen years--despite its excellent performance as a fixed bi-directional array of modest proportions. With two 44' long wires spaced 22' apart, the extended or expanded Lazy-H provides primary service on 20 through 10 meters, with quite adequate service on 30 and even 40 meters. From each element center, we run a parallel feedline--in phase--to a center position, which then becomes the primary feedpoint. We may use any feedline from 300 Ohms to 600 Ohms, although any figures shown in these notes will apply to 450-Ohm line with a 0.95 velocity factor. These notes also presume AWG #14 or #12 copper wire for the elements.

The base of the antenna ideally should be about 44' or more above ground for the lowest elevation angles of maximum radiation (take-off or TO angles). However, if necessity prevent the top wire from reaching 66', then a lower height and higher elevation angles are tolerable.

"The Expanded Lazy-H," at this site provides a set of representative elevation and azimuth patterns for the antenna. The following table summarizes the performance when set at a 44'-66' height. The gain is the maximum gain at the TO angle. The Beamwidth is the angle between half-power or -3 dB points away from the bearing for maximum gain. The feedpoint impedance (Feed Z) is at the junction of the two 11' lengths of 450-Ohm parallel line.

Extended Lazy-H Performance Potential

Freq. MHz	Gain dBi	TO angle degrees	Beamwidth degrees	Feed Z R+/-jX Ohms
28.5	15.1	8	31	64 + j 425
24.95	14.6	10	41	17 + j 115
21.1	12.5	11	52	22 - j 18
18.118	10.9	13	61	43 - j 125
14.1	9.0	17	73	403 - j 395
10.125	8.1	24	85	49 + j 105
7.1	6.3	33	99	10 - j 100

The impedances are all quite manageable for a wide-range balanced antenna tuner, with the possible exception of 40 meters and 12 meters. However, the impedance at the tuner will also be a function of the line length in wavelengths from the feedpoint to the tuner, so adjustment of the values to be matched is feasible.

Planar Reflectors

My reason for returning to the extended/expanded Lazy-H grew out of an inquiry from Bill Burton, T88BA of Pelau. He had assembled the pieces for the antenna. However, he had also seen some commercial arrays that used a curtain-style reflector. Hence, he asked whether such a reflector was feasible for the big Lazy-H.

I have seen a number of schemes for multiple extended double Zepps of about 44' and even for the Lazy-H, all designed to use parasitic elements or phased elements to convert the bi-directional array into a directional beam. Their complexity could be daunting, often with the result that only the builder knew the correct adjustments for each band. On the other hand, a planar or curtain reflector is a broad-band passive addition that might be serviceable.

In UHF work, a planar reflector generally exceeds the dimensions of the active element or array by perhaps 3/8 to 1/2 wavelength on all four sides. Such a curtain would be somewhat ungainly for the extended/expanded Lazy-H. So I somewhat arbitrarily selected a set of dimensions that seemed close to feasible for someone with sufficient land to erect the basic antenna at the ideal minimum height. The modeled screen is 50' wide by 30' high. This is only 6' wider than the element lengths and 8' larger vertically. In many ways, it is a minimalist planar reflector.

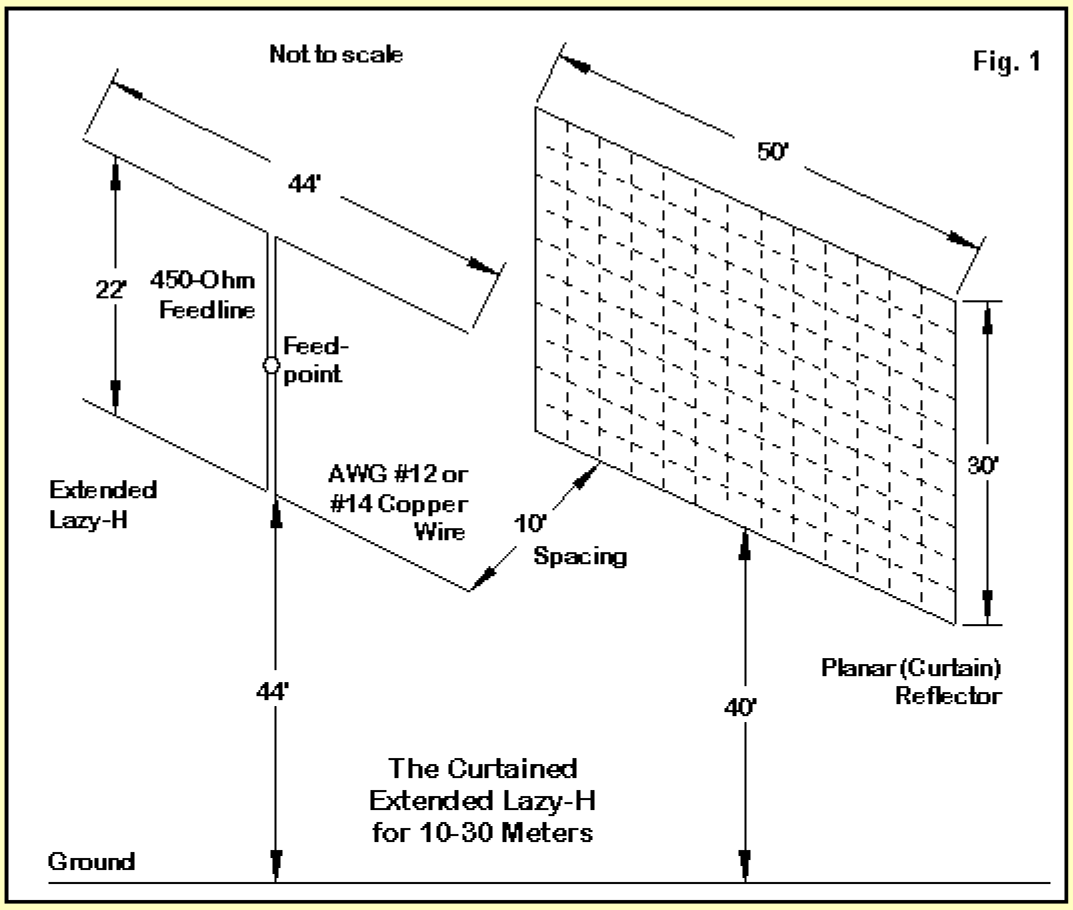


Fig. 1 shows the parts of the array, although not to scale. The extended/expanded Lazy-H remains unchanged from independent use which results in its bi-directional characteristics. The screen is centered behind the active array. Although the modeled screen uses a grid-square assembly, it is possible to use a sequence of wires parallel to each other. For this horizontal array, the wires must also be horizontal.

The 10' spacing was my initial trial spacing for the reflector--just a bit shy of 1/4 wavelength at 15 meters. After looking at numerous other spacings, I returned to my intuitive selection, since it provides approximately equal front-to-back ratios at the array limits, namely 10 meters at the high end and 30 meters at the low end.

To see how the curtain or planar reflector changes array performance, examine the following table and compare various values to the ones for the array alone.

. . . .

Curtained Extended Lazy-H Performance Potential

Freq. MHz	Gain dBi	TO angle degrees	Beamwidth degrees	F-B Ratio dB	Feed Z R+/-jX Ohms
28.5	18.4	8	30	13.7	112 + j 430
24.95	17.1	10	40	15.5	29 + j 125
21.1	15.5	11	50	17.1	25 - j 3
18.118	14.4	13	56	16.8	33 - j 100
14.1	13.1	17	63	14.2	175 - j 460
10.125	12.2	23	69	13.8	21 + j 140
7.1	10.0*	30	75	8.3	2 - j 100

. . . .

The gain increase in the favored direction is between 3 and 4 dB, depending upon the band, with peak increases in the 17 and 20 meter bands. The gain improvement values are consistent with those for any casually designed 2-element driver-reflector Yagi. Peak front-to-back ratio occurs on 15 meters and decreases slowly above and below that band.

The impedance values are interesting. No great change occurs in the reactance values. However, the resistive component shows an interesting pattern. On 15 meters, its value is about the same as the value for the array alone. Above 15 meters, where the spacing is greater than 1/4 wavelength, the resistive component of the impedance is higher than for the array alone. Below 15 meters, the resistive component is less than for the array alone, while the spacing is less than 1/4 wavelength.

Fig. 2 through **Fig. 7** provide azimuth and elevation patterns for the array on each band. They require no individual comment. However, the trends in the rear lobe formations should be reasonably clear. In all cases, the patterns are well-behaved, with no spurious lobes--other than the emergent secondary lobes inherent to the array when the active element length approaches 1.25 wavelengths.

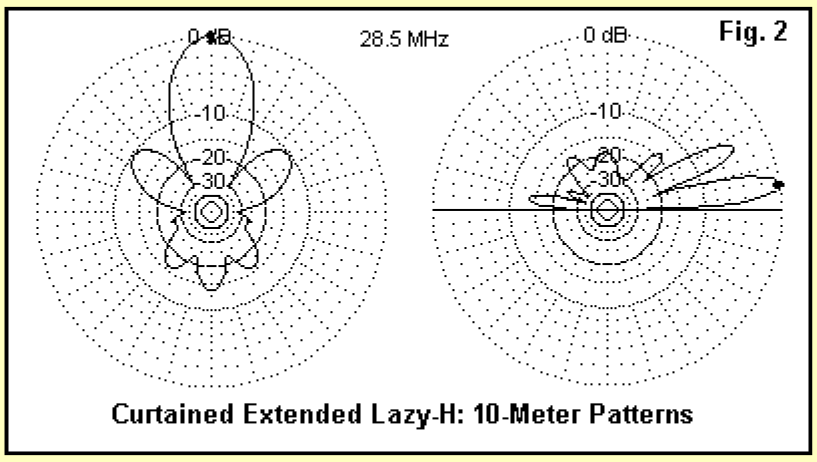
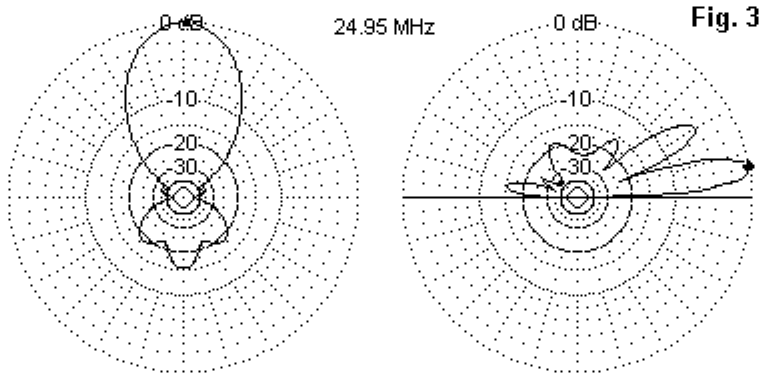


Fig. 2

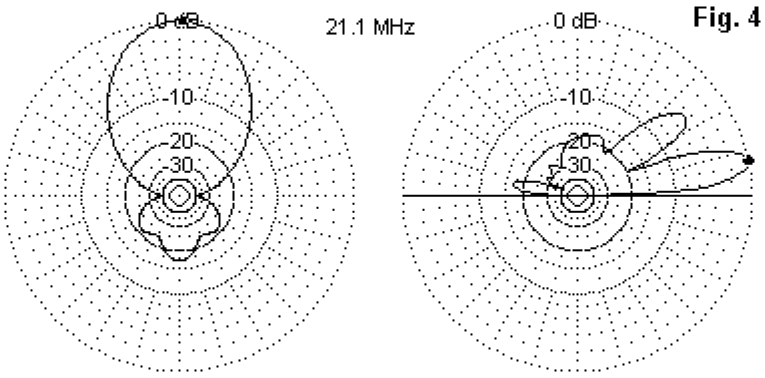
Curtained Extended Lazy-H: 10-Meter Patterns

Fig. 3



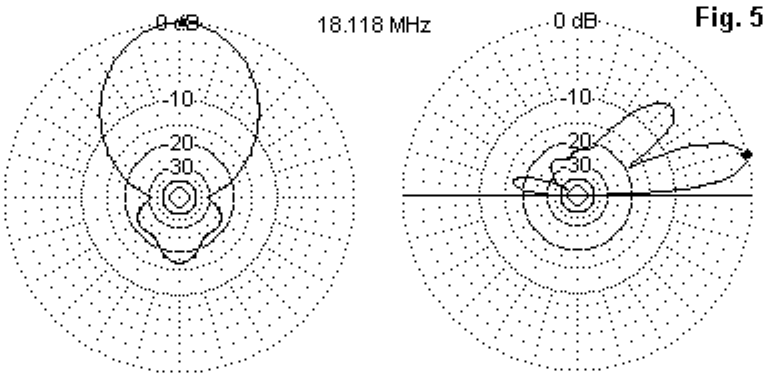
Curtained Extended Lazy-H: 12-Meter Patterns

Fig. 4



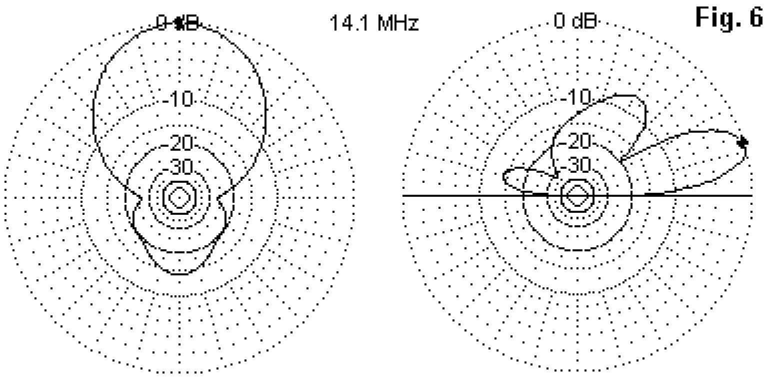
Curtained Extended Lazy-H: 15-Meter Patterns

Fig. 5



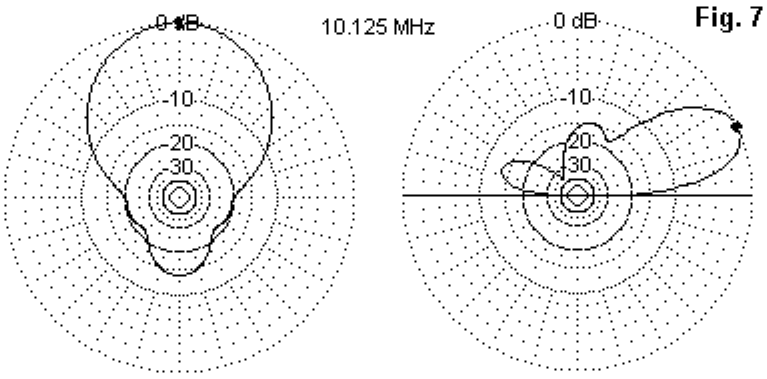
Curtained Extended Lazy-H: 17-Meter Patterns

Fig. 6



Curtained Extended Lazy-H: 20-Meter Patterns

Fig. 7



Curtained Extended Lazy-H: 30-Meter Patterns

Before leaving our patterns, we must take special note of 40 meters. The gain value for that band is starred. That star indicates that the pattern shows maximum gain in the reverse direction relative to all of the other bands. See **Fig. 8** for azimuth and elevation details.

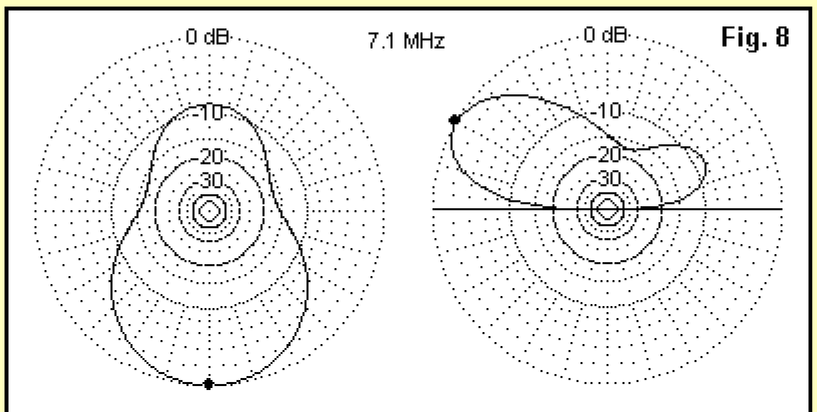


Fig. 8

Curtained Extended Lazy-H: 40-Meter Patterns

The reason for pattern reversal is simple. The horizontal dimension for the reflector (50') is 1/2 wavelength or more for all bands from 30 to 10 meters. However, on 40 meters, the reflector horizontal dimension is only about 3/8 wavelength. Hence, despite its vertical dimension, the screen acts like a director at less than 0.1 wavelength spacing. The very low resistive component of the feedpoint impedance reflects this condition. It is unlikely that one would be able to take advantage of the reverse pattern, given the potential difficulty in achieving a low-loss match.

Physical Realities

The proof-of-principle exercise suggests that a minimalist planar reflector or curtain behind an expanded/extended Lazy-H will yield a competent directional beam with a noticeable improvement in gain and quite usable front-to-back characteristics. However, the requirements for the reflector are sufficiently challenging to make this array an antenna with a somewhat small niche.

Planar reflectors require both vertical and horizontal dimension for highest effectiveness. Too narrow a vertical dimension will degrade the array characteristics as much as too short a horizontal dimension. Since the reflector is untuned, it must be at least 1/2 wavelength at the lowest frequency used, with additional length up to about 1 wavelength wherever feasible. Vertically, we improve performance with height greater than those used here, although the vertical dimension will reach its limits of helpfulness more quickly than the horizontal dimension.

Assuming that we can erect vertical supports of the needed height, I recommend some form of halyard assembly to raise and lower the reflector screen. Even an extremely open "chicken-wire" screen reflector will show considerable aggregate wind resistance in violent storms. However, if one desired beaming in both broadside directions, then a pair of screens--with only one raised at a time--will yield a reversible beam. If the user has only one primary target region, lowering a single screen will return the array to its inherent bi-directional pattern, and that may suffice for other operations.

For raising and lowering, we need an open-weave metal "fabric" that will resist snagging when it is crumpled on the ground. However, one might wind the screen around a ground-level cylinder instead of lowering it into a heap directly on the ground. One might even use a combination of horizontal wires and vertical ropes to create a more flexible screen for this purpose. The final product is suited to the skills of one who has experience with square-rigged sails, with the sail and spar arrangement inverted from those we find at sea. Of course, we shall invert another matter as well: we shall seek to slip the wind rather than catching it.

The curtained Lazy-H is a fixed position wire array of considerable mechanical size and requires equal mechanical ingenuity to implement. However, it holds promise of providing multi-band gain and front-to-back ratio so that the operator can use the upper HF band on which propagation is nearest to optimal for a desired path. The beamwidth on the upper bands is narrow enough to require careful siting. Although the values in the charts emphasize the amateur bands, the general arrangement may be suitable for short-wave listening in the intervening spectrum--and possibly even for an economical short-wave broadcast installation.

The curtained Lazy-H is certainly not an antenna for everyone. But it may be an antenna for someone.

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