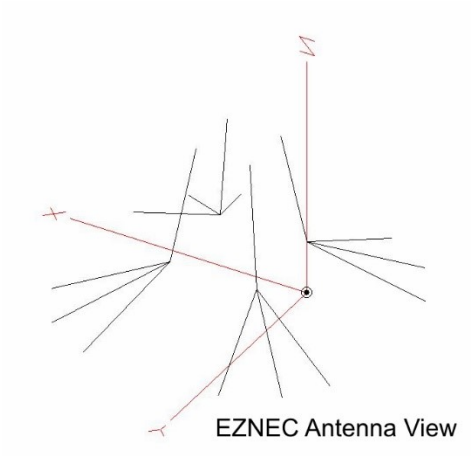
# A 4 VERTICAL ARRAY FOR 30M

By Arie Kleingeld PA3A




## An Antenna Project

The idea for this antenna project originates from Les EA5AVL (SK) who built the '40m Compact 4-Square Antenna'. A very nice concept indeed, 4 wire verticals and only one supporting mast. I always wanted to try this one out and decided to build a light weight 30m version of it for portable use, perhaps a DXpedition. I wanted to design it from scratch, using EZNEC and not scaling the original design. There were constraints though: all antenna components had to come from the PA3A junkbox and the array should be light weight and portable.

## A 4 Vertical Array (like a 4-square) for 30 meters

The antenna has one radiator and 3 reflectors. All elements are a sort of sloping dipoles and have the same length. To let 3 elements behave as a reflector, they need to be loaded with an inductance. This is an easy job if you know that a quarter wave transmission line converts a capacitive reactance to inductive reactance. A brilliant idea that was implemented in EA5AVL's antenna. Different from the original design of connecting all reflectors to one common capacitor, I decided to connect each reflector to its own capacitor and decouple the quarter wave coax feedlines with simple common mode chokes. With this concept common mode currents are reduced, simulation in EZNEC is clean and easy, and it turned out to give a realistic outcome.

## EZNEC

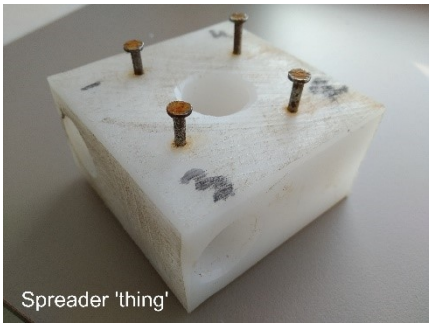
So, the EZNEC (NEC2) homework was done. Length of all quarter wave element wires came to about 6,65m, which seems a bit short for 10 MHz but all wires are covered with 0,75mm PVC coating which has a shortening effect. Playing with the height of the array above ground level and separation distance of the elements gave a nice insight of the possibilities in gain and F/B ratio. Being constrained by the support structure I settled for:

– Top of antenna at about 9m
– Separation of the wires at the top as in a 4-square with sides of 3m (so 2,25m from middle support mast)
– Separation of the feed points at about 3,5m from the middle support mast (as a 4-square with 5m sides)

The EZNEC prediction with these dimensions was about 3dB gain over a single groundplane antenna and a F/B ratio of 15-20 dB for modest elevation angles (see the pictures below). SWR would turn out to be about 1 : 1.3 at the resonance frequency. And after building and tuning, I could conclude that this was a very accurate prediction! Never been so close to reality with EZNEC. You can download the EZNEC-file at: https://pa3a.nl/wp-content/uploads/2021/11/PA3A-30m-4-Vertical-Array.zip

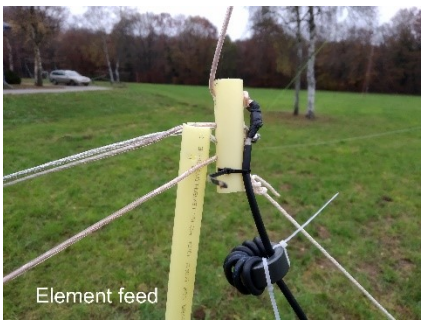
# The Actual Build

Setting things up for the first time is not a quick job. Cutting all wires to the right length, measuring the velocity factor of the coax (came down to 0.66, as in the specs) and cut 4 quarter wave feedlines, soldering it all together, construction of an antenna switch, etc. and finally tuning it all to the 30m band.


Spreader 'thing'

Components of the contraption:

- 12m vertical of Spiderbeam (set to about 9m)
- PVC pipe spreaders and supports
- A spreader ‘thing’ made by Mart PH0MH (snug fit for PVC pipes) to connect the horizontal PVC pipes to the mast
- Loudspeaker feeder cable as antenna wire
- 4 x 1/4 wave 50 ohm RG-58CU coax feed (length about 4.88m) with common mode chokes
- All elements connected to a capacitor of 440 pF (= 2 x 220 pF) in the switch box through a 1/4 wave coax cable
- CAT-6 cable to switch the relay box
- (Too) many guy-lines
- Switching relays in the box are capable of handling 16A – 240V; they were donated by Henk PA3D


Element feed

- The switchbox is at the centre near the Spiderbeam mast. A deactivated relay connects each 1/4 wave feeder to its 440pF cap. If one of the four relays is activated, it switches one element (the radiator) to the transmitter coax, the other three elements stay connected to their 440 pF caps and act as reflectors.

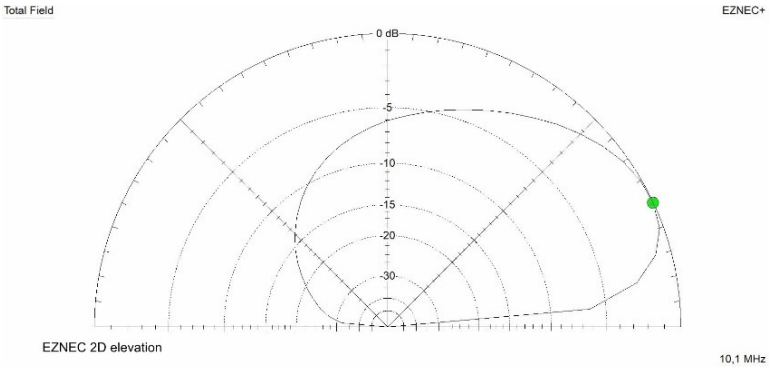

## Results

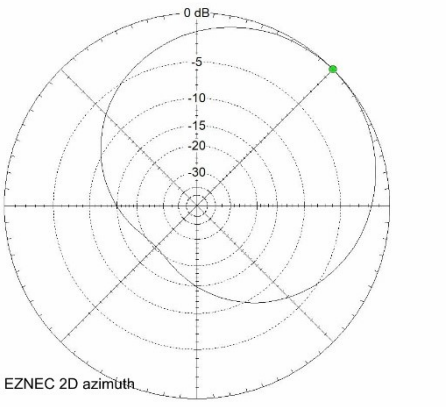
The performance of this array was better than I expected. It's an antenna with parasitic verticals and my experience is that the results of such a system is different from a regular 4-square antenna with 4 RF-fed verticals and a good radial system. Well, it held up pretty good and came close to what EZNEC predicted. Probably because the verticals were more like sloping dipoles, so that the radials were not on the ground but were elevated. Difference in gain compared to the reference antenna (a groundplane antenna with 4 radials about 100m away from the 4-square) was not much, but there was a clear difference in S/N ratio because of the directivity of the 4-square. The F/B ratio was very satisfying. Front, side and back of the array were clearly distinguishable.

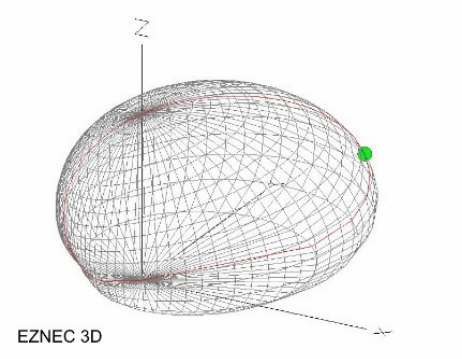
## Demonstration of Results on YouTube

For a good view on the antenna array and for demonstration of the F/B ratio, I made this 2-minute YouTube video: https://www.youtube.com/watch?v=V5kWw_9Mlgo

## EZNEC Graphs of the 4 Vertical Array




Links: The EA5AVL article:
https://rsars.files.wordpress.com/2013/01/40-m-compact-4-square-antenna-ea5avl-11.pdf

73,

Arie Kleingeld PA3A