Antenna Workshop

John Heys G3BDQ describes an antenna design for medium sized gardens that can work well on the h.f. bands.

A simple description of a 'V' antenna could be: 'a doublet with its ends drawn together'. Each leg of a horizontal 'V' antenna can be thought of as a pair of long wire antennas and that the two legs can provide directional gain over the doublet when each leg is at least one wavelength long. The element pair is arranged with an included angle that's dependant upon the number of wavelengths in each leg.

I hope the description above isn't too confusing as there are two variables involved. To get maximum gain, the angle between the legs of the antenna may range from 90° (for legs one wavelength long), down to 35° when each wire is eight or more wavelengths long. The antenna to be decribed here, has a leg length of at least 15m (50ft) and although it's relatively small, can still be used effectively on all bands from 1.8 to 28MHz.

At 28MHz, each leg of the 'V' will be almost two wavelengths long and so, can have a gain of about 4dB over an half-wave dipole. In the 21MHz band, the gain falls slightly to around 3dB. The radiation pattern in the horizontal plane is off the apex and the open end of the V.

On the lower frequency bands, ie. 3.5, 7 and 10MHz, the radiation will be fairly high angle and tend to be 'all round'. As the number of wavelengths in each leg of the 'V' increases, the vertical angle of the radiation falls, a feature that enhances long distance communication.

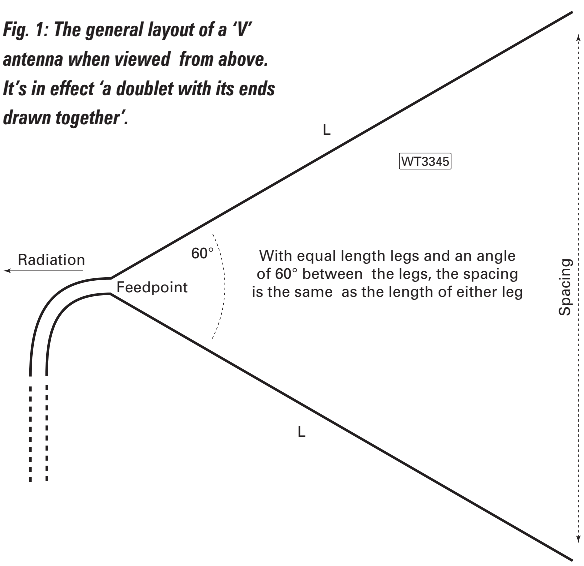

Fig. 1: The general layout of a 'V' antenna when viewed from above. It's in effect 'a doublet with its ends drawn together'.

My version of the antenna, as described in this article, slopes down towards the open ends of the V, which further lowers the radiation angles on the higher frequency bands. With a horizontal 'V', the vertical angle of radiation is quite low, at 31° when the leg length is only one wavelength.

The radiation angle reduces to about 23° when using legs that are three-wavelengths long. The radiation angles are reduced further when the antenna slopes but it means that the angle is raised in the direction away from its apex and feedpoint.

A long wire has most of its low-angle radiation off and away from its ends. The 'V' antenna with each leg fed out-of-phase, allows the end-lobes of the two wires to be combined. To achieve maximum gain, the included angle of a 'V' must be chosen to allow the end lobes to coincide perfectly. My version has a compromise angle between the wires of 60°, an angle that still allows respectable gain figures on the bands higher than 14MHz.

On the lower frequency bands the angle (when using such relatively short legs for the 'V') becomes irrelevant for there's no gain expected at those frequencies. The choice of a 60° angle is also useful when planning a practical version, for the two antenna wire legs and the distance between the ends of those legs make up an equilateral triangle. This helps in the decision of leg length and whether the antenna will fit into the space available. A sloping 'V' with 15m (50ft) legs will obviously need a garden of at least this width.

Other Bands

What about the other, lower frequency bands you may ask? The answer is that even when the antenna has no gain over an half-wave dipole, the sloping 'V' will still prove to be an efficient radiator, with its higher radiation angles giving useful signal strengths for short and medium distances. On the 3.5 and 7MHz bands this antenna should be useful for working most European countries. It should also on occasions during winter months, even allow real DX.

Feedpoint Impedance

The impedance at the apex-feedpoint of the V, will vary with both frequency and the layout of the antenna. On some bands the feed-point impedance will be more manageable but it may also be as high as 2kΩ on other bands! This rules out using coaxial cable as a feeder, a balanced two-wire feeder is essential for this antenna, which can be a home-brew ladder line with insulated spreaders or the commercially available plastic 300 or 450Ω ribbon feeder. Commercial feeders usually have rectangular holes along its length to reduce some of the effects of rain or snow.

An a.t.u. used to match into this antenna will need a balanced output capability, which rules out almost all the commercial auto-tuners. **Note:** It also certainly rules out the internal a.t.u.s of many transceivers. In the latest MFJ Catalogue I did see that a few of their very extensive a.t.u. range were designed with a balanced antenna connection.

Practical Points

Now, for some practical points about siting the antenna. At the feedpoint, which is at the apex of the 'V', the antenna must be at least 9-12m (30-40ft) high and the two shorter supports at the far ends of the antenna can be between 2.5-3m (8-10ft) high. This will give a slope angle of around 30° for the antenna wires. Instead of a support mast at the feeder end of the V, part of the house such as a chimney stack or a small pole fastened to a wall could be used.

The feeder should come down almost vertically and be kept away from any metal masts. If an insulated mast (such as a fibreglass one) is used, then the feeder can come down quite close to it. The shorter end masts will not need guying if they are set well into the ground, for the weight of each wire leg is not great.

I would suggest that in this design, and in fact in most wire antenna designs, 1.5-2mm (18 or 16s.w.g.) copper wire is used. This should be hard drawn to prevent stretching and will avoid the nasty problems that can be associated with multi-conductor wires encased in plastic.

Once used, the wires will become tarnished from weathering, despite the insulating cover and will be difficult to solder if they are used again for a new antenna project. Incidentally, I have known of several cases where the inner wire strands have broken because of of windage and this break was hidden by the plastic insulation.

The breaks gave rise to a mysterious

situation where a previously good antenna suddenly became untuneable. My present long wire has some copper wire along its length that was purchased more than 40 years ago and despite some 'greening' from my local sea air still performs perfectly.

The antenna as described is suitable for medium sized garden plots but if you are fortunate enough to have access to a large garden or field a 'V' can be constructed with much longer legs. If the antenna legs were about 80m (265ft) and the angle between the legs was reduced to 50°, the 'V' would have 7dB gain over a half wave dipole on 14MHz. On 28MHz this gain would rise to 9dB despite the included angle not being correct for the antenna length.

It often happens that the combination of antenna and feeder lengths can give rise to tuning problems on one or more bands. It is because the two lengths can together present the a.t.u. with an extreme (low or very high) input impedance. I've encountered this problem many times and the solution is to change the feeder length by experiment. It's obviously easier to lengthen the feeder down at the shack end.

My present antenna has this problem on 3.5MHz and as it's a single wire radiator, I inserted a coil in series with it and the a.t.u on that band. The 'V' antenna will work beautifully on 1.8MHz if the feeder wires in the shack are 'strapped' (shorted) together to become a top loaded vertical. Used with a good earth system it should give an excellent performance for local and even DX work in the winter months.

My own personal experience using a 'V' antenna goes back to an early National Field Day (NFD) 56 years ago, I arranged for three 91m (300ft) wires arranged to work as two 'V's each having a 60° angle at the apex. A special multi-wire home-brew ladder line was switched before connecting to the a.t.u. and when using just 10W input to a 6L6 valve on 14MHz

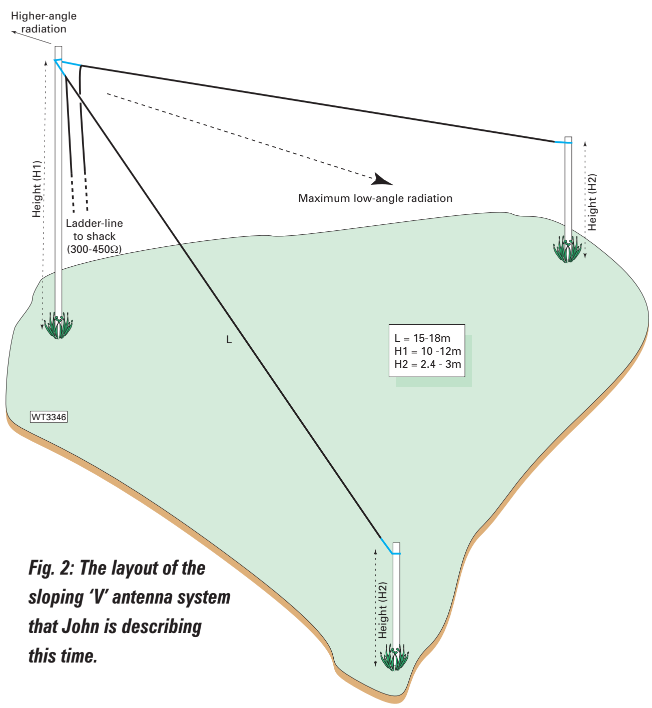

Fig. 2: The layout of the sloping 'V' antenna system that John is describing this time.

Finally

Finally, this is an ongoing project as *PW's* editor **Rob G3XFD** is experimenting with a sloping 'V' antenna and to date has had considerable success. He will no doubt tell the readers of his findings when they are completed. If you aspire to a little 'one upmanship' and have received a particularly good report tell the chap at the other end that your antenna is an unterminated half-Rhombic, a statement that's actually quite true! ●