corner-fed loop antenna for low-frequency dx

Design data for a triangular loop antenna covering 80 through 10 meters

For those amateurs who can't erect a beam antenna for one reason or another, a triangular-shaped wire antenna provides a fair compromise. On these pages you'll find details of such an antenna that has given a good account of itself on all the high-frequency bands. It requires little more space than an inverted vee. However, the antenna does require some means of support that is at least 70 feet (21.3m) high. Advantages of the antenna are:

A. Feedline can be coax cable, TV twin lead, or open wire line.

B. Only one support is needed.

C. Vertical radiation angle seems to be quite low, which is needed for DX work.

D. Results on all bands (except 160 meters) appear to be better for long-haul DX than with the sloping dipole, or inverted vee, which is band limited.

triangular antennas

Several triangular wire antennas have been described.[1,2] These are single-band antennas that are variations of the full-wavelength loop. Such antennas, when mounted vertically and excited at the center with second and other even-harmonic energy, radiate straight up -- not the best for DX work.

G3AQC conducted tests of loop antennas close to ground using vhf modeling techniques.[3] He found that full-wave quad and delta loops mounted in the vertical plane with their highest points one-quarter wavelength above the ground, fed symmetrically with the feed point halfway along the base or at the apex, produced high-angle, horizontally polarized radiation and showed little superiority over a simple dipole or inverted vee at one-quarter wavelength height. These configurations are shown in **fig. 1**.

If a delta loop is inverted so that it has a flat top and its apex points down, as in **fig. 2**, a low-angle, vertically polarized lobe appears, which is omnidirectional in the horizontal plane. G3AQC gives details of a practical antenna of this type, which is said to perform well on all bands from 80 to 10 meters and to have a radiation resistance of around 200 ohms.

corner-fed loop

Even more interesting is the result obtained when a delta loop is fed at one end of the horizontal section, as

By Barry Kirkwood, ZL1BN, 11 Bromley Place, Auckland 6, New Zealand

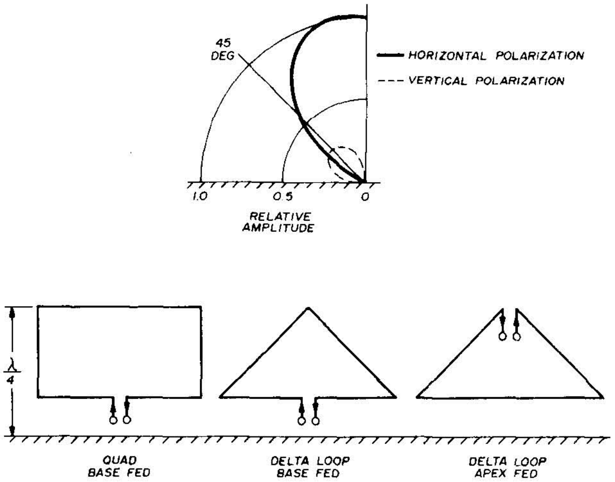

fig. 1. Full-wave loops close to ground. Radiation pattern is little different from a dipole at 1/2 wavelength above ground.

in **fig. 3**. In this case the horizontally polarized radiation is suppressed. The signal is concentrated into low-angle, vertically polarized radiation. The radiation patterns are much the same for both upright and inverted loops; hence the upright delta loop seemed to be the configuration of choice since it required only a single supporting mast.

G3AQC gave no information on the performance of such an antenna on harmonic frequencies. Since the configuration looked attractive, I decided to try such a loop (270 feet, or 82.3m overall) as an all-band antenna.

A triangular 275-foot (83.6m) loop of insulated hookup wire was erected with the apex at 70 feet (21.3m), and the corners of the base were suspended by insulated cords to nearby trees at 15 feet (4.6m). The droop of the base section was within 10 feet (3m) of ground level at the lowest point, which was directly below the apex. Using a simple rf bridge, the length of wire in the loop was adjusted for resonance slightly above 3.5 MHz, where the radiation resistance was 65 ohms. On

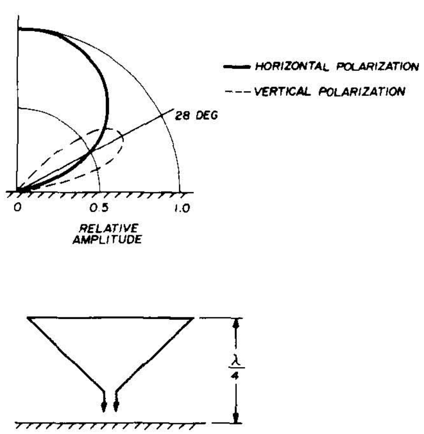

fig. 2. Inverted delta loop at 1/4 wavelength above ground showing vertical radiation pattern in the plane of the loop. Note the low-angle vertical lobe. (After G3AQC.)

the second harmonic (resonance in the 7-MHz band), radiation resistance was about 200 ohms and increased slightly on the higher bands, approaching 300 ohms on 28 MHz.

feed system

The antenna was fed with 300-ohm line. An antenna coupler of the Z-Match type was used to couple the line to the transmitter, as in **fig. 4**. The side of the line connected to the base of the antenna loop was grounded at the antenna tuner, mainly for lightning protection. (Little or no discernible change occurred in loading or performance on transmit or receive with the ground connection on or off.)

G3AQC states that this antenna is fundamentally unbalanced. If it is fed with coax line, the braid should be attached to the horizontal leg of the antenna.

The antenna can be fed with coaxial cable, twin lead, or open-wire line with minimal loss and moderate impe-

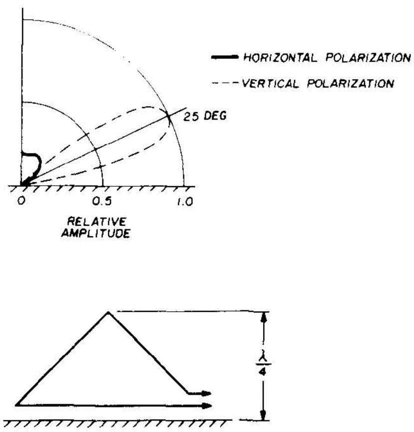

fig. 3. Delta loop, corner fed, showing low-angle, vertically polarized radiation.

dances occurring at the transmitter end of the line. An antenna coupler is recommended, not only for improved efficiency and hamonic reduction but to prevent out-of-band signals from overloading the receiver.

evaluation

Antenna evaluation is difficult because of the variables involved. The task is even more difficult because of the patchy band conditions that have prevailed since the loop was erected. The antenna is located on a typical suburban site, which is cluttered with buildings, small trees, and power lines. A low ridge is between my station and the major DX propagation paths: northwest to Europe and northeast to North America. Comparative results with other amateurs in Auckland when using other antennas at ZL1BN indicate that the location is only fair for DX on these paths, although it is quite good on the long path to Europe. The antenna is oriented along a line 110-290 degrees true, which puts it end-on to Rome and Lima and broadside to Alaska and South Africa.

On 80 meters, DX seems at least as good as with an inverted vee at the same apex height. Too few DX openings have occurred to evaluate directivity, although theoretically directivity should be almost omnidirectional on the long haul. At intermediate ranges, out to about 3000 miles (4800 km) the loop is clearly superior to anything ever used at this station.

On 40 meters performance appears superior to a ground plane used previously. Exceptionally good reports have been received both from Europe and the USA, especially under marginal conditions, which indicates that low angle propagation exists both broadside and end-on on this band.

Reports from South America have been good, but it's

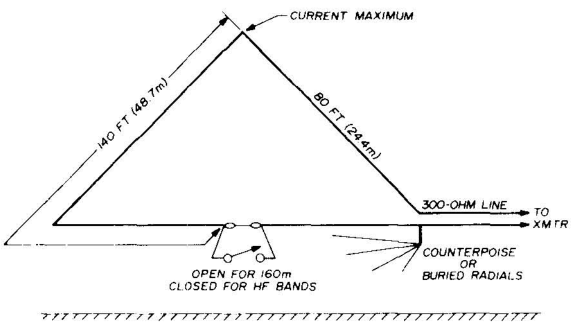

fig. 5. Possible conversion of loop for 160-meter DX operation. Counterpoise or buried radial system should be as extensive as possible. Fanout of ground system below antenna will assist operation on all bands.

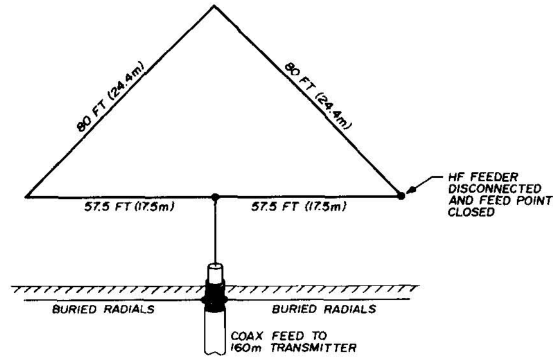

fig. 6. Possible conversion of loop to a vertical monopole radiator for 160 meters.

top band

No attempt has been made to try the loop on 160 meters. If the loop were opened opposite the feed point, it would resonate as a dipole on that band, but results would not be good, since the current point would be close to the ground. It might be better to open the horizontal leg of the loop so that the current point would be at the apex, and the other side of the feeder could be connected to a radial or counterpoise ground, as shown in **fig. 5**.

Another possibility might be to feed the lower geometric center with a single wire and work it against

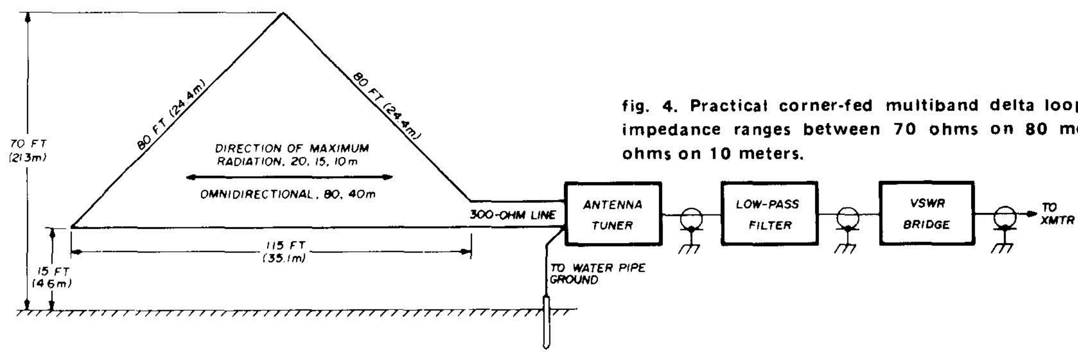

fig. 4. Practical corner-fed multiband delta loop. Feedpoint impedance ranges between 70 ohms on 80 meters to 300 ohms on 10 meters.

possible that radiation is better in the direction away from the point of connection of the feedline. Signal strengths from the loop run about 3 dB below antennas of nearby amateurs using Yagis at 40 to 60 feet (12-18m) above ground. Signals are weaker broadside to the plane of the antenna. The answer might be to suspend a bisquare array or quad loop for 20 meters in the plane of the big loop. This combination could give good coverage on 20 meters and would be inexpensive and easy to install.

Poor band conditions have prevented an adequate evaluation of performance on 21 and 28 MHz. The relatively few contacts made indicate that the pattern is similar to that on 14 MHz with broad lobes off the ends of the loop and nulls on the sides.

ground (**fig. 6**). According to Krause[4] a half-wave loop fed in this way should show true resonance as a vertical quarter-wave antenna against ground without loading coils. All such experiments can be carried out at ground level.

references

1. Edward Noll, W3FQJ, "Triangle Antennas," *ham radio*, August, 1971, page 52.
2. Pat Hawker, G3VA, "Multiband Loops and Quads," *Radio Communication*, February, 1973, page 100.
3. L. V. Mayhead, G3AQC, "Loop Aerials Close to Ground," *Radio Communication*, May, 1974, page 100.
4. John D. Krause, W8JK, *Antennas*, McGraw-Hill Publishing Company, New York, 1951.

ham radio