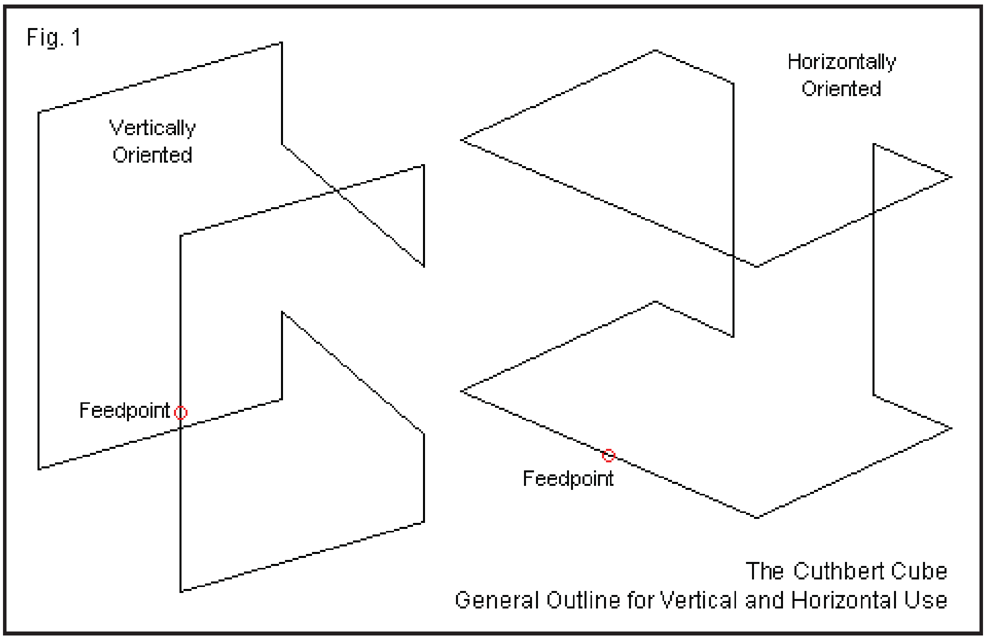
No. 57: A Different Kind of 10-Meter Attic Antenna

L. B. Cebik, W4RNL

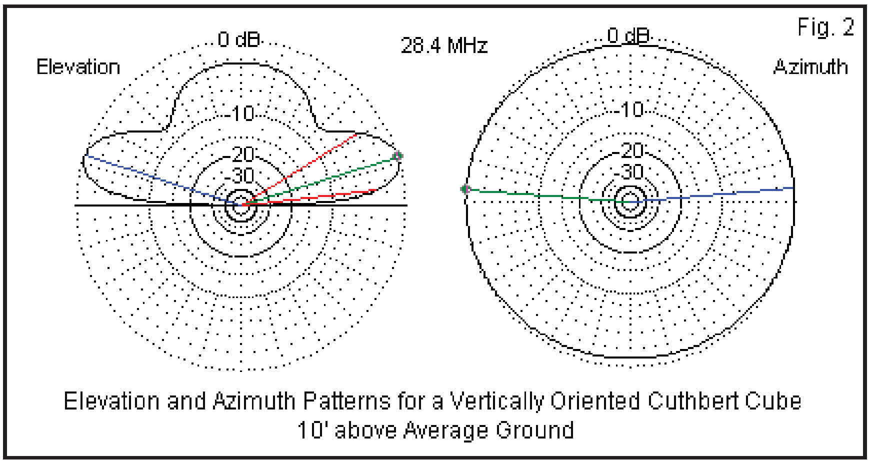
Due to restrictive covenants, many 10-meter operators must use attic antennas or devise other ways to hide the antenna. Older ranch-style homes used to be long and narrow. Hence, many attic antennas are dipoles oriented along the length of the attic. A 10-meter dipole is about 200" long. The operator had to orient the dipole according to the attic space, which might or might not place the wire broadside to the best target communications areas.

The last decade or so has revised home architecture so that the long attic is gone. In its place is a collection of smaller attic spaces, often with more vertical than horizontal room. For these spaces, we need a new kind of attic 10-meter antenna--one that will largely free us from orientation worries and still perform well in the confined space. It must still keep its distance from all metal wiring, ductwork, and foil sheathing. Enter the Cuthbert Cube.

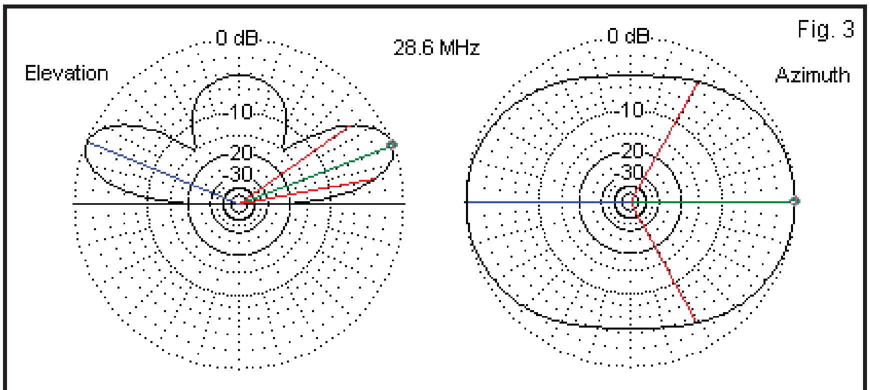
A few years ago, Dave Cuthbert, WX7G, used some basic antenna folding ideas that had appeared in antenneX, an on-line antenna experimentation journal, and developed a 2-meter antenna as a desktop improvement on the usual FM rubber ducky. The design evolved from bending, folding, but not mutilating the 1-wavelength quad loop with a side feedpoint for vertical polarization. However, we can easily tip over the Cuthbert Cube (which is not quite truly cubical) and obtain horizontally polarize patterns, just like a bottom-fed quad loop. **Fig. 1** shows the 2 orientations.



The equivalent of 2-meter desktop height is probably 10' at the antenna bottom for the left part of the sketch, the vertically oriented cube. If we take patterns at that height, we obtain the elevation and azimuth plots on **Fig. 2**. The gain is modest on 10 meters: less than 1 dBi at an elevation angle of 17 degrees. However, the pattern is nearly circular for the small volume occupied by the antenna.



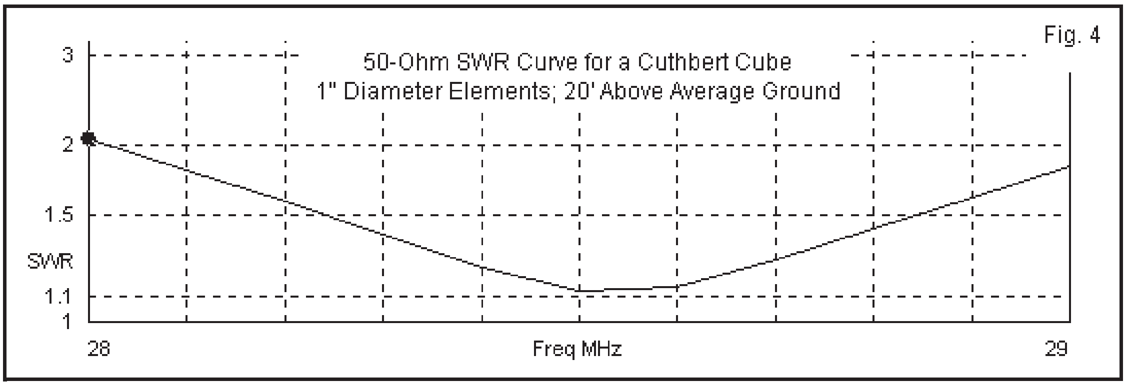
More relevant to 10-meter CW and SSB use is the horizontal orientation. If we assume that the modern attic allows a 20' height above ground for the bottom wires, then we obtain the patterns in **Fig. 3**. The elevation angle is about 21 degrees, which is lower than for a dipole at the same height. Because we have a loop and the vertical wires carry some current, there is some vertically polarized radiation. So the azimuth pattern is not a traditional dipole figure-8, but instead a broad oval. The maximum gain lies along a line through the feedpoint and the gap between the rear vertical wires and is between 6.7 and 6.8 dBi, less than 1 dB lower than a dipole at the same height. However, the radiation to the sides is only about 5 dB below maximum, enough to hear signals in those directions when the propagation is good.



Elevation and Azimuth Patterns for a Horizontally Oriented Cuthbert Cube
20' Above Average Ground

The 10-meter version of the Cuthbert Cube is about 5'-3" on the feedpoint line. The vertical and the front-back dimensions are identical: 3'-7". Hence, some version of the antenna should not only fit within a small attic, but we should also be able to orient it for maximum gain in desired directions.

The antenna is a closed loop and hence does not change its impedance much as we change height. The resistive part of the impedance is 50 Ohms at the design frequency. However, this antenna has a peculiarity: The inductively reactive part of the impedance increases as we reduce the element size. Hence, for element diameters from about 5/8" downward, we need to add a series capacitor in line with the feedpoint. A 75-pF to 100-pF variable from a hamfest sale will work fine. However, if we use 1" elements, then we no longer need the series capacitor, since the inductive reactance is no longer present at the design frequency. As well, we increase the passband covered with under 2:1 SWR to include all of the first MHz of 10 meters. Wire versions cover about 600 kHz of the band. **Fig. 4** shows the 50-Ohm SWR curve for a Cuthbert Cube with 1" elements.

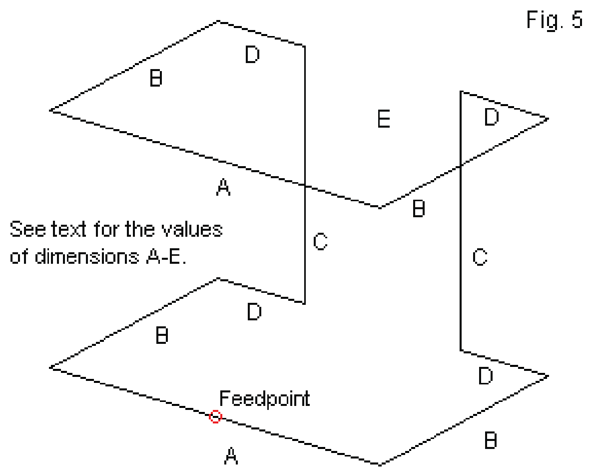


Building the Cuthbert Cube requires a set of dimensions. The following table shows 2 sets: one for 28.4 MHz and intended for wire versions of the antenna. The second set shows dimensions for a design frequency of 28.6 MHz and is intended for the 1" version. **Fig. 5** provides a guide to which dimension goes where. Dimension E is the gap or open space between the vertical wires in the antenna. The dimensions are equally applicable to the antenna when used vertically.

Dimensions for the Cuthbert Cube: All dimensions in inches

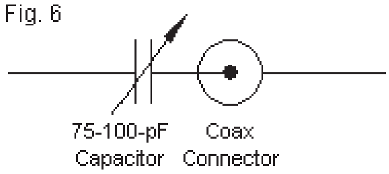
28.4-MHz Design Frequency		**28.6-MHz Design Frequency**	
Dimension	**Length**	**Dimension**	**Length**
A	**63**	**A**	**62.5**
B	**43**	**B**	**42.75**

C	**43**	**C**	**42.75**
D	**16.75**	**D**	**16.5**
E	**29.5**	**E**	**29.5**



Dimension Guide to the Cuthbert Cube

A wire version will require some form of support structure. In a dry attic, wood and PVC--or some combination--are good candidates. You will likely need corner supports and a way to prevent the wires from pulling the ends of the supports toward each other. It is also likely that you will need two more supports for the vertical wires. Since these wires have low current, you can run the wires next to the support posts, rods, tubes, or dowels. You will also need a short support for a plate to hold the coax connector and the series capacitor. **Fig. 6** shows a simple schematic representation of the feedpoint with a single variable capacitor. Once you know the required capacitance to produce the lowest SWR at the design frequency, you can replace the variable capacitor by a fixed capacitor of the right value. However, be sure that it can handle the power of your transmitting equipment. 500-volt capacitors are usually adequate for most standard transceivers.



Feedpoint Arrangement for a Wire Version of the Cuthbert Cube

The 1" element version of the antenna does not require a series capacitor. In fact, it does not even require tubing. You can substitute 1" per side L-stock, which is available at many home centers. The stock usually comes in 1/16" and 1/8" thicknesses. The thickness will make no significant electrical difference, but the weight ratio is 2:1. However, heavier stock is somewhat more rigid. The stock easily let's you create nut-and-bolt corners. As well, you can mount a coax connector directly onto the element at the feedpoint and run a bridge wire from the connector pin to the continuation of the element on the other side of the small (1/4") gap. You can choose whether the connector points horizontally or downward, depending on the likely coax run in your attic and walls. Use any handy plastic strip to join the parts of the element on each side of the gap to sustain a physically rigid element.

One advantage of this form of construction is that you can build everything in the shop and then break the antenna into pieces that you can get into the attic. A screwdriver and a nut-driver may be all the tools you need for in-place final assembly. As with all attic antenna, you want to raise it off the ceiling joists. You can hang it from the rafters or devise a wood or PVC set of elevating supports. The specific construction of your attic and how you want to orient the antenna will make your installation a custom effort.

A stronger alternative construction method is to use copper pipe with a 1" outside diameter. (Piping sizes are "nominal," that is, listed by the minimum inside diameter, not the outside diameter. You will have to check the actual outside diameter of the pipe you select.) You can torch-solder or sweat the corners with 90 degree junctions. Only the feedpoint requires special attention to create a gap for the coax connector while retaining a rigid element. I do not recommend torch flames in the attic. So use this method of construction only for outdoor service or if your attic let's you fit the finished antenna through the entry.

The horizontal Cuthbert Cube may not fit everyone's needs--or even everyone's attic. But for some 10-meter operators, it might make the difference between being on the air or not.