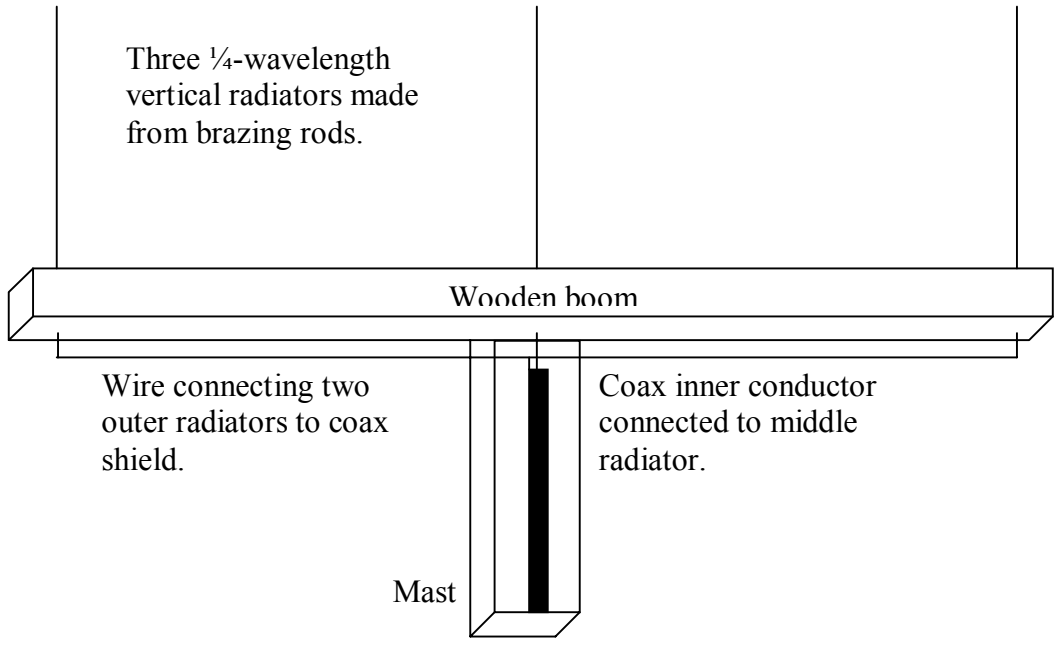
Weekend Antennas No. 1
A Bobtail Curtain for 2m

Welcome to the first installment of my new column, which I hope will become a regular feature in Radio ZS. Each installment will present a practical and interesting antenna design that can be built in a weekend with simple tools and common materials. Although the column will be first and foremost a practical one, I shall also attempt to explain in each case how the antenna works and the theoretical performance expected of it, aided where appropriate by computer simulations. I welcome questions and other correspondence about these or other antenna ideas and will attempt to publish answers to any questions when space allows.

This month's subject is a vertically polarized bi-directional antenna for the 2m band with a free-space gain of 6.0 dBi, which is about 4.7 dB better than the traditional quarter-wave vertical, making it ideal for accessing distant repeaters. The aerial is easy to construct, provides an excellent match to 50Ω coax and is easy to tune because it has a wide bandwidth (the 2:1 SWR bandwidth is about 7 MHz) over which the pattern and gain remain consistent. It even has an interesting name, the "Bobtail Curtain"!

The design of the antenna is simple (see diagram below). It consists of a 1.8 m wooden boom, with three vertical ¼ wavelength radiators. The two outside radiators are connected together, and fed against the central radiator.



The antenna is fed through a simple choke balun (not shown in the diagram), which prevents unbalanced currents on the feed-line that might otherwise cause the feed-line to radiate.

Construction Details

To build it, you will need:

- A piece of wood 1.8m long for the boom. I used a standard sized pine from the local hardware shop, 22mm x 22mm x 1.8m long.
- Another piece of wood to use as a mast.
- Three brazing rods made of brass or copper, at least 65 cm long. The thickness is not critical, provided they are strong enough to stand upright in the wind, but thin enough so you can trim them to size. Mine were 3mm in diameter.
- 1.8 m of stranded insulated electrical wire. The $1mm^2$ "panel wire" available from electrical shops works well.
- A 60mm length of 40mm diameter white plastic plumbing pipe.
- A few metres of RG-58 coax that will serve as the connection to the antenna with a suitable connector (for instance, a PL-259 UHF connector) on one end.
- A quickset epoxy-resin adhesive.
- Paint or varnish to weatherproof the boom and mast.
- Cable clips (the nail-in "saddles") to attach the coax cable to the mast.
- Self-vulcanizing rubber tape.
- Nails or screws to attach the boom to the mast.

Screw, nail and/or glue the centre of the boom to the top of the mast, at right angles. The mast should be attached to one side of the boom, so that the bottom of the boom remains accessible, as in the diagram above. Varnish or paint the whole assembly to weatherproof it, and leave it to dry overnight.

Drill three holes just big enough to fit the brazing rods through the boom from top to bottom. One hole should be in the middle of the boom, the others should be 15mm from each end of the boom, and all should be centered from side to side. Cut the brazing rods to 65 cm long (it is important that they are all the same length) and epoxy them into the holes so that 5 mm of each rod comes out of the bottom of the boom.

Cut the insulated electrical wire so it is just long enough to connect the two outside radiators. Remember to leave enough spare wire for the solder joint on each end. Carefully remove about 5mm of insulation from the middle of the wire. Solder the ends of the wire to the two outer radiators where they protrude below the boom.

To make a simple choke balun drill two holes through one side of the plastic plumbing pipe about 1cm from either end. The holes should be just large enough for

the coax to fit through; 5.5 mm works well with RG-58 coax. Pass the free end of the coax (the end without the connector) through one of the holes, from the inside of the pipe to the outside. Wind six or seven turns of coax around the pipe, then pass the end through the hole at the other side of the pipe, this time from the outside to the inside, leaving about 6 cm of coax protruding from the inside of the pipe to connect to the antenna. Secure the turns with cable ties or a little glue from a glue-gun. (See picture for details).

Detail of the Choke Balun

Strip 2.5 cm of the outer insulation from the coax (the end protruding from the choke balun) and about 1 cm of the inner insulation. Solder the inner conductor of the coax to the middle radiator where it protrudes below the boom, and the shield (braid) to the middle of the wire connecting the two outside radiators, where you previously stripped 5mm of the insulation. Wrap the joints with self-vulcanizing rubber tape to prevent the coax inner and outer from short-circuiting. (In a pinch you can use normal insulation tape, but self-vulcanizing rubber tape is much more weather-proof.)

Secure the choke balun to the mast using cable clips around the coax immediately above and below the balun. Run the coax down the mast, attaching it to the mast every 20cm or so using cable clips (these are important to take the strain off the solder connections).

Raise your new antenna in the clear (away from conductive objects, including yourself) and use an SWR meter or antenna analyzer to trim the radiators for the best match to 50Ω (minimum SWR). You should trim the same amount off each of the

radiators, so the three radiators remain the same length. The final SWR should be very close to 1:1 since this antenna has a feed-point impedance of almost exactly 50Ω at resonance. Trimming is easy due to the wide bandwidth of the antenna.

The Completed Antenna (excluding Balun)

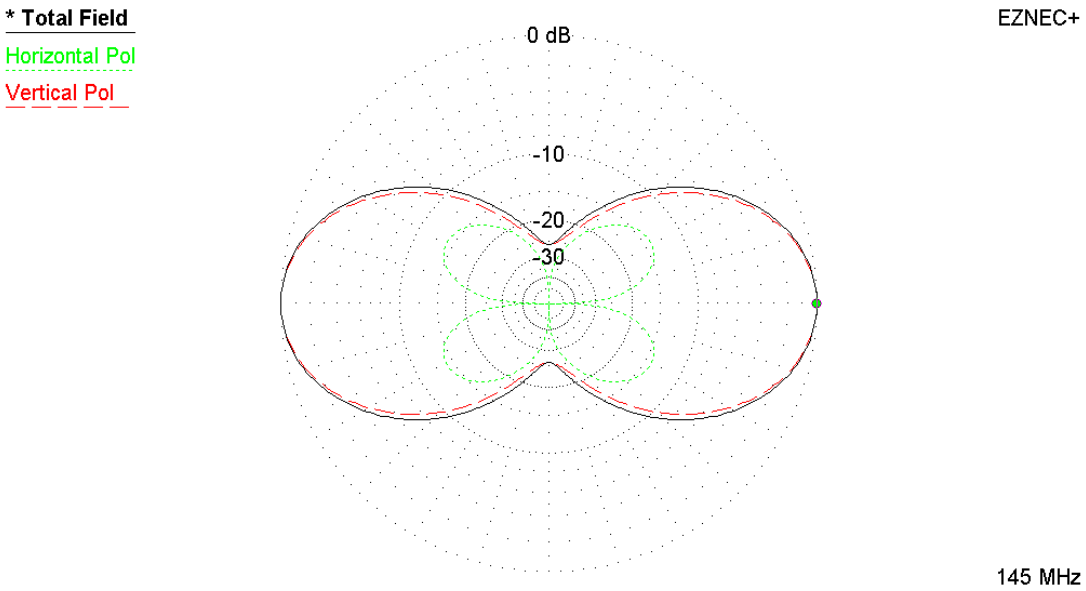
How it Works

The Bobtail Curtain operates as a broadside array of three ¼-wave radiators in phase. Broadside (that is, at right angles to the beam) the fields from the three radiators reinforce each other, so in these directions the radiation is at its maximum. In the direction of the boom, the radiation fields from the two outer radiators cancel the field from the middle radiator, so these are the directions of least radiation. The wire connecting the braid of the coax to the two outside radiators acts as a phasing line, keeping the currents in the radiators in the correct phase relationship (in this case, in-phase for all three radiators).

The feed arrangement, with the middle element being fed against the two outer elements, ensures that the current in the middle element is twice that in each of the outer elements, which is just the right ratio to get the desired pattern. Note that the pattern is bi-directional as shown in the plot below – that is, it radiates equally well in both (horizontal) directions at right angles to the boom.

Since neither of the feed-point connections is at RF earth potential, good practice dictates the use of a balun to prevent radiation from the feed-line. The balun used here is a choke balun consisting of six or seven turns of coax wound around a plastic

former. Any unbalanced RF currents flowing in the coax will generate a varying magnetic field, and the choke will act as an inductor, exhibiting a high (reactive) impedance to common-mode (unbalanced) currents. However balanced (equal and opposite) currents flowing in the coax generate no net magnetic field, so the choke balun has low impedance for differential currents.



Radiation Pattern of the Bobtail Curtain

The diagram shows an azimuth plot (i.e. seen from above) of the far-field radiation pattern of the Bobtail Curtain. The free-space gain is 6.0 dBi. The small horizontally polarized component is contributed by the phasing lines.