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Dish It Out

—home-brewing a parabolic reflector, with the focus on cost

Some months ago, I began searching for a parabolic reflector to augment some gear for the reception of GOES weather satellite transmissions on 1691 MHz. A reflector on the order of 6 to 8 feet in diameter seemed like a good compromise, so the search went on . . . and on.

After looking over some "finds" that several more fortunate hams had made, I began to realize that if you did locate a dish this size, you'd better have a fat wallet and a strong back.

Luckily, I happened upon an article by Norm Foot WA9HUV, in a May, 1975, issue of *Ham Radio* on open-grid parabolic reflectors.[1] This excellent article, along with some others (references 2, 3, and 4), and suggestions and formulae from Roy Cawthon who has had numerous articles in *73* regarding weather satellite pictures during the past several years, started me on this project. I'm grateful to both sources. You won't find any theory here—no proof of performance curves, etc. This is more in the nature of a nuts and bolts kind of article to encourage you along the same route. I can assure you that with a generous amount of diligence and average amount of dexterity (and little over $100 at this date), you'll have a good parabolic reflector. See Photo A.

Photo A. 8-ft. parabolic reflector. Elements are 5/8" aluminum tubing spaced 3". Reflective surface is reinforced with ¼" hardware cloth. The cylindrical horn is a 2-lb. coffee can with probe.

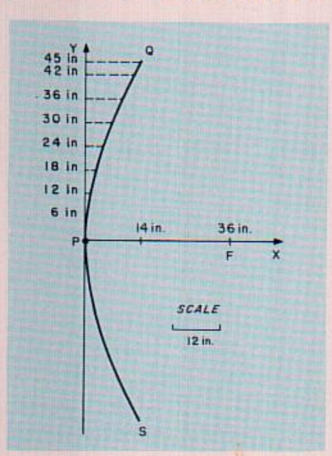

Fig. 1. Parabolic curve generated using $x = y^2/144$. Results are shown in Table 1.

A word about materials: This reflector is 2.3m (7½') in diameter. 8-foot lengths of 5/8" o.d. aluminum tubing (.049" wall thickness) were used. The tubing is the type found in hardware store do-it-yourself displays, a type that is easily bent and remains so after being bent. More rigid material, 5/8" electrical conduit, was used for the two main supporting members to which the elements are attached.

An F/D (focal length to diameter) ratio of 0.4 had been recommended as opti-

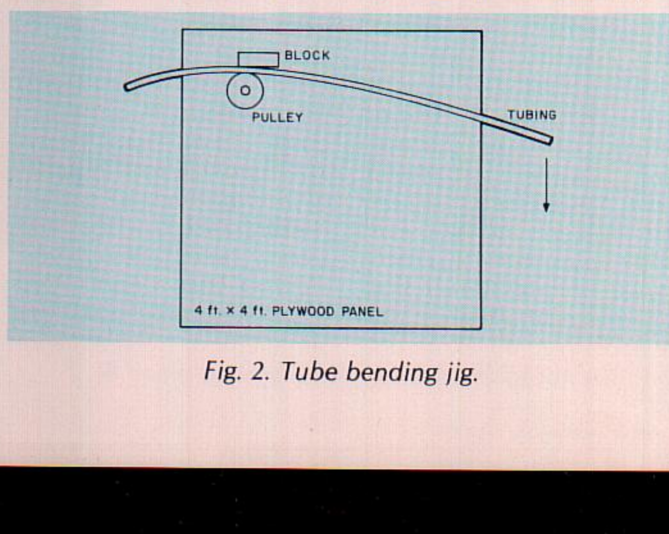

Fig. 2. Tube bending jig.

mum to facilitate illumination of the parabolic reflector. Following this, I chose a focal length of 36″ and a diameter of 90″. Element spacing is 3″ on center (close to the 0.439 wave figure for 1-dB loss in Mr. Foot's data). To get at the business of element cutting (and use tubing cutters, by all means!), Fig. 1, Table 1, and the relations shown in the Math Box were used.

Element lengths, together with number required, are shown in Table 2.

Reflector Construction

A template will be needed to check bending and forming of the aluminum elements to fit the parabolic curve. Assigning 36 inches for focal length and solving $x = y^2/144$ produces the results shown in Fig. 1 and Table 1. Nails or screws at the x and y points will define the curve. The principal tool in the project is a tubing bending jig—that is homemade, too. I used a 4′×4′ sheet of 1/2-inch plywood and mounted a 5-inch pulley and hardwood block according to the scheme shown in Fig. 2.

Mark the center of each of the elements. Slip the end in between the block and pulley, advancing the tubing in small bites and gentle bends. The pulley will aid in keeping the tubing parallel to the plywood surface. After just a few bends (even on the very first element), you'll get the feel of it.

I began with one of the longer (95″) elements, fashioning it to the parabolic curve, then using it for a pattern for the remaining elements. After all the aluminum elements are formed, proceed to the two conduit supporting members. These will require a little more "tug," but you'll be a pro by that time.

The two supporting pieces (conduit) now are

x	y
¼	6
1	12
2¼	18
4	24
6¼	30
9	36
12¼	42
14	45

Table 1. Curve coordinate dimensions (inches).

ready to be marked for drilling. An easy way to mark the center line is to make a scribe, using a wooden block and finishing nail. Drill a pilot hole in the block at half the tubing o.d., then insert the finishing nail. Place the conduit member on a level surface (the bending jig) and scribe the center line. Starting at the center of the conduit piece and working toward each end, mark off 3-inch intervals. Punch and drill these intersections with the center line, using a 7/64″ bit. Drill through just the front wall. A 9/64″ bit will be needed for the aluminum elements.

Number 6, 1-inch zinc chromate tapping screws (pan head) are used to fasten the aluminum elements to the conduit supports. Begin with the 32-inch end elements. Measure in 4 inches from each end of the 32-inch elements and using the 9/64″ bit, drill through the elements. Attach the elements to the conduit supports, squaring up the assembly. From now on it's just a matter of centering each element on the frame, marking and drilling the elements, and attaching them with tapping screws. (A pair of sawhorses can be used to hold the frame, making the job easier on the back.) After all elements are in place, the conduit supports are prevented from sagging by inserting small "S" hooks in each end and connecting these with supporting lines of number 18 galvanized wire.

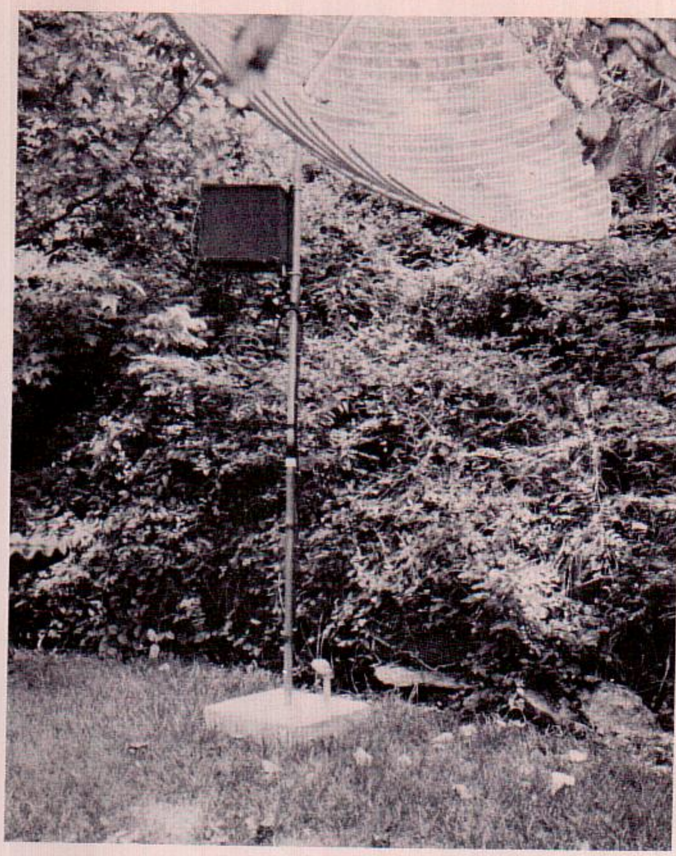

Photo B. Pedestal mount.

Boom Construction

A 26-inch length of 2×4 (treated with several coats of redwood preservative stain) is used for the top member of the boom. The assembled reflector is centered on the boom and attached with U-brackets and brass screws, using two brackets for each conduit support. See Fig. 3.

Install a 1-inch floor flange at the center of the boom to accept the cylin-

2 each (lengths rounded to nearest inch)

32	84
46	87
55	90
63	92
69	93
78	95
80	95

1 central section, extending to 96 inches, to be made of two 46-inch lengths installed on either side of a 1-inch floor flange centered on the boom. (27 lengths of tubing should do it.)

Table 2. Element lengths and number required.

Math Box

1) $r^2 = x^2 + y^2$—for sides and hypotenuse of right triangle.
2) $y^2 = 4Fx$—parabola at origin.
3) Arc QPS $= \sqrt{4x^2 + y^2} + \frac{y^2}{2x} (\log_e) \frac{2x + \sqrt{4x^2 + y^2}}{y}$ — length of arc of parabola.

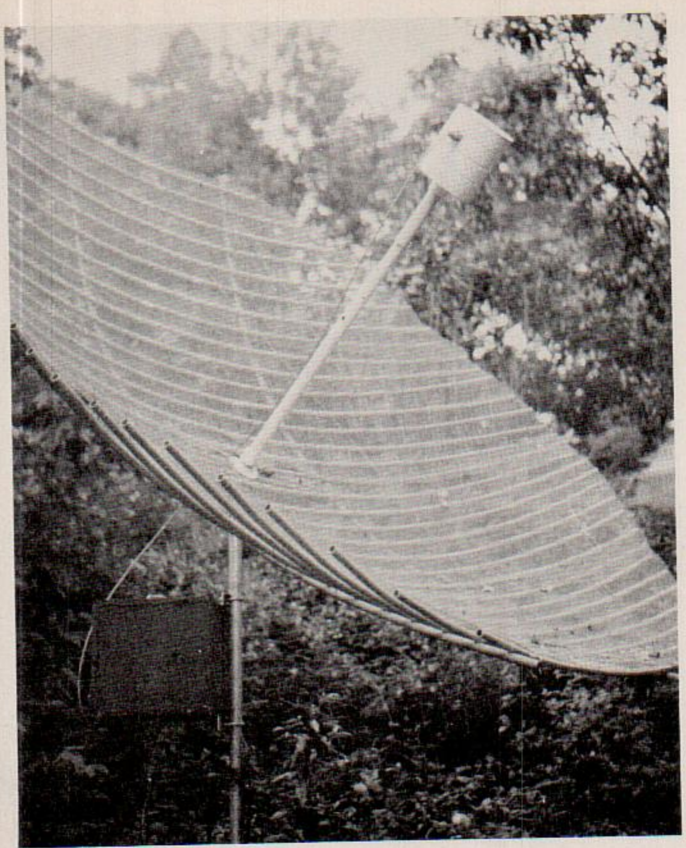

Photo C. Downconverter housing mounted on mast.

drical horn assembly. The horn support is made of 1-inch PVC (plastic) pipe. Cut a 24-inch piece of pipe and install a 1-inch male adapter at one end, using PVC cement. Cut a 12-inch length of 1-inch dowel rod, give it several coats of redwood stain, and install it in the open end of the PVC pipe section so that about 8 inches of dowel extends from the pipe. Attach this assembly to the floor flange.

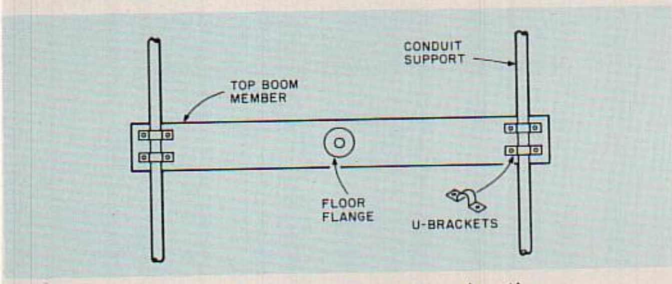

Fig. 3. Boom construction details.

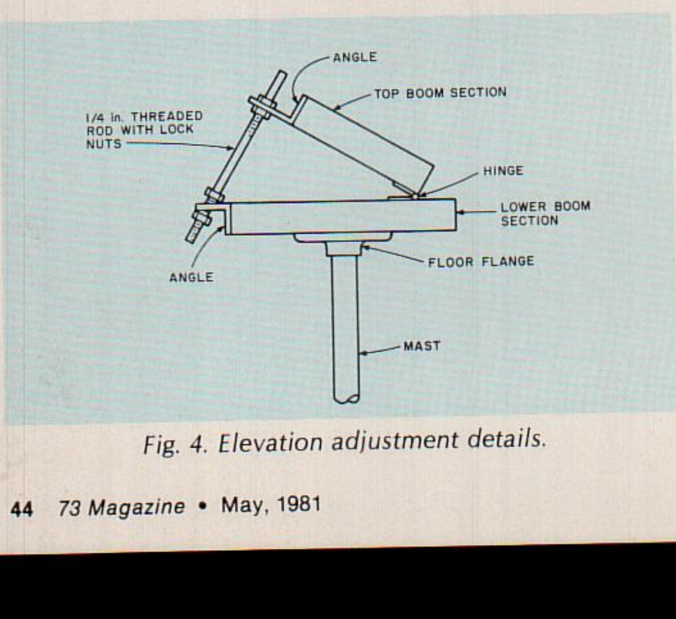

Fig. 4. Elevation adjustment details.

Elevation adjustment is provided by two pieces of 2-inch aluminum angle, 2 inches long, coupled by a 6-inch length of 1/4-inch threaded rod. See Figure 4. The lower boom section is a 26-inch length of 2 × 6 (treat with perservative stain). Another 1-inch floor flange is fastened to the bottom center of this member (use brass screws). The two boom sections are joined by 3-inch brass butt hinges. Attach the elevation control assembly as shown.

The completed parabolic (open-grid) reflector should weigh about 40 pounds. In order to thread it onto the mast, I inserted a 1/4-inch lag screw about 4 inches long into the center of the lower floor flange. This "pins" the assembly to the mast, making assembly a lot easier.

Pedestal

Posthole diggers were used to a depth of about 2 feet, then a form for the pedestal 18 inches square by 6 inches deep was constructed. A 10-foot length of 1-inch galvanized pipe, along with a section of 1-inch conduit (containing RG-8/U and 24 V ac lines) was set in the form. The block was poured, using several bags of ready mix. See Photo B.

Cylindrical Horn

The horn was constructed according to Taggart's article.[5] Using 3/8-inch Plexiglas™, a disk is cut to fit the open end of the 2-lb. coffee can (about 5.9 inches). Using an expansion bit, cut a hole in the center of the disk large enough to accept a 1-inch male PVC adapter. Cut a 1-inch PVC union into two parts. Install a 1-inch male adapter at one end of a 10-inch section of 1-inch PVC pipe. Insert this into the disk and snug it up with the piece of union just cut. Install the disk in the open end of the coffee can, drilling and tapping the Plexiglas disk for six 4-40 screws.

Downconverter Housing

A weatherproof box (11″ × 12″ × 15″) of 1/2-inch outdoor plywood houses a MicroComm RX1691 downconverter. The box was treated with preservative stain and caulked with a generous amount of clear silicone seal. Actually, it's a box within a box, the converter being further enclosed by sections of 1-inch thick styrofoam. A regulated 12-volt dc supply shares the housing with the downconverter. See Photo C.

I used the open-grid reflector for several months, getting good results (usually full quieting) on the two GOES satellites I monitored: GOES Central and GOES East. Recently, I covered the reflector, installing sections of 1/4-inch hardware cloth (24-inch width) to the inside of the reflector with loops of number 18 galvanized wire; I'll admit that there has been some slight improvement in performance. I will certainly say that the open-grid performance was well within what one could expect from Mr. Foot's data.

The project looks much more formidable than it really is and the method easily could be extended to the fabrication of larger dishes, say, for TVRO satellite use. ■

References

1. "Open-grid Parabolic Reflectors," Norm Foot WA9HUV, *Ham Radio*, May, 1975.
2. "Cylindrical Feed Horn," Norm Foot WA9HUV, *Ham Radio*, May, 1976.
3. "12-Foot Open-grid Parabola, "Norm Foot WA9HUV, *QST*, June, 1971.
4. "Simple and Efficient Feed for Parabolic Antennas," Vilardi, *QST*, March, 1973.
5. "Be A Weather Genius," Taggart WB8DQT, *73*, November, 1978.