Budget Beams using Fiberglass Reinforced Plastic (FRP) rebar - Stuart Beyer, KJ4CYV

I decided to write this up as I think its a great project for others to expand on, is inexpensive, and is easy to build. Using fiberglass rebar combined with wire seems to be a winning combination. It would be very practical to make beams for the 1.2, 2, 6, and 10 meter bands using this type of construction. Here is how I got started... and have fun!

Having never used 6 meters to any extent before, I wanted to get started by getting on our local 6 meter "50215.net". I was located 30 miles east of where most of the NCO's on the net lived but just could not pick up the net. There are many tall trees around my home which are great for hanging vertical end-feds, but a vertical 6-meter J-pole up high did not work out. Figured out later that while height is important, horizontal polarization was key. But I was not up for the complexity of stringing cords across trees to hang a 6-meter horizontal wire dipole either.

Hanging a commercially made aluminum beam from a tree was an idea I quickly abandoned as it could be easily damaged from the tree swaying in a heavy wind banging around or having a dead branch fall on it. As well, the price of aluminum stock has gotten ridiculously expensive so building anything with that was out of the question. I figured wire would work and be inexpensive, but how could I make it hold its shape? Last, anything made would need to be rugged enough to withstand being knocked about on a swaying pine tree without being damaged. Wooden dowels and PVC pipe were considered but pvc pipe sags and fittings get expensive fast. Wood warps and can be conductive and would affect the performance or tune when wet.

The solution I found was fiberglass rebar. Its a common item at home improvement stores and it's available in 10 and even 20 foot lengths and in 3/8 and 1/2" diameters. And it's inexpensive! At the time of this writing - June 2026 - it is about $6.50 for a 3/8" 10' fiberglass rebar. Around $10 for a 20' section. It is tough, strong, and bends back to its shape just like a fishing pole. Please note that it could be slightly prickly like a cactus off the shelf as-is. That is easily fixed - see my note about handling new rebar in the 'Other Notes' paragraph near the end of this article.

My first 6-meter dipole was made with a 10' rebar. Nothing more than THHN 14 gauge wire simply taped to it. I used a 1" copper pipe union cut in half lengthwise, flattened out and drilled to hold a SO-239 connector. See Figure 1.



I used #4 hose clamps to fasten 3/4" PEX pipe crimp rings to the rebar to tie paracord onto for hanging. See fig. 2.



PEX Crimp rings fastened to the rebar provided a solid mounting point for the stabilizing cords

The arrangement ended up looking like a very large coat hanger - See Figure 3.



The dipole cost about $12 for materials and it worked! While the area I live in is somewhat flat, that dipole about 45 feet up in a pine tree easily gave me a 30 mile reach on 6 meters. Most importantly, the dipole proved that FRP rebar is RF transparent. But others on the net were still difficult to hear so I needed a better antenna! I wonder how many other hams have said that?

Adding a reflector to a dipole delivers the single highest gain. While 0.20 of the wavelength's distance between the reflector and dipole is the optimal spacing, 0.15 is close to optimum which was used to make the beams as compact as possible. Building the two-element beam significantly improved my reception and others were complimenting me about how my signal strength had improved. It's what I am using every day now and I strongly recommend the 2-element design. It is compact and lightweight.

I spray-painted it with 'camo' colors and its nearly invisible up in the tree. And it even has a usable bandwidth of around 1 Mhz. See Fig. 11

I even built a 3-element beam, using about 0.15 wavelength spacing between the reflector and the dipole, and about 0.20 spacing from the director from the dipole. Both work! I made a number of FT8 contacts in 31 states, France, Mexico, Portugal and Spain and 6 Canadian Provinces so far. My 'rotator' was nothing more than a string tied to the back of the beam tied to something on the ground to keep it aimed.

I could not find any instructions how to tune a two or three element wire beam from scratch, so I found the following build methods by trial and error. I am sure that there may be more optimal methods to tune them, but they all yield an acceptably low SWR and they perform well.

Building the two-element beam:
See Figs. 4 & 5 for the dimensions. The wire lengths shown should be tuned very close to 50.2 Mhz. I used 1 1/4" gray PVC electrical conduit because it is tough, UV resistant, and a 10' section is around $15. Even if it is RF sensitive, it had no affect on my beams. I started off by cutting the conduit to length and drilled through the conduit which will hold the two rebars in parallel. Drill the holes using a 3/8" drill straight through and as accurately as you can. It is important that the holes hold the rebar at 90 degrees to the conduit and that both rebars need to be in the same plane with each other as possible. I used a small drill press to do this. The 3/8" rebar will not fit in a 3/8" hole. You will then need to slightly enlarge the 3/8" holes with either a 13/32" drill bit, a reamer, or a round chainsaw file - you want a snug fit.

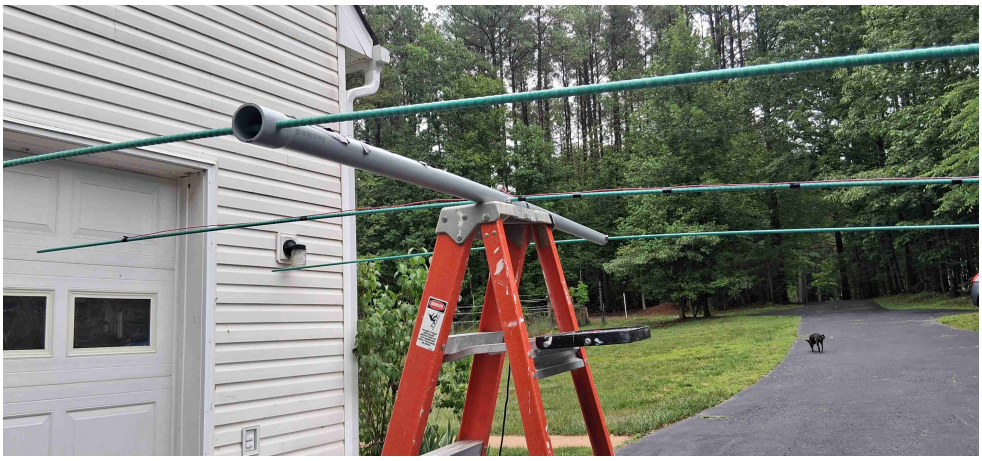
Leave the rebars their original length - it is important that you do not cut them for a later step. Center them on the conduit. This is best done by balancing the conduit to ensure they are centered. This is important else your antenna may tilt to one side when hung. Then lock the rebars in place using a #4 hose clamps pushed closely to the conduit. Be careful to not overtighten the clamps as they can strip out. Beware of cheap clamps online! Many are not stainless or are made of soft metal that strips out.

Constructing the driven element:
This is a 'Direct Feed' antenna. There is no no matching section, gamma or hairpin match. You will tune it for a specific frequency by trimming the driven element. Take your desired frequency and then find the wavelength. Divide the wavelength by 4. If you are using 14 gauge THHN insulated wire, then multiply that by around 0.89 which should be the *approximate* length of your dipole. If using bare wire, it will probably have a higher velocity factor and your dipole elements may end up being a little longer than shown on the plans. To be sure you're not too short, add an extra three inches to each side of your dipole and then solder a SO-239 connector to the center wire. Solder a ring terminal to the other wire and fasten that to the SO-239 connector with a stainless steel (preferably) #6-32 nut and bolt. See Fig. 6. Tape the driven element wire to the driven element rebar to be as straight as possible.



Tuning the dipole - This applies to the 6-meter dipole and the 2 and 3 element beams:

I used a 6 foot fiberglass ladder and set the antennas on top of that to tune them. Spacing is important! 6 feet is far enough away from the ground to not have any affect when tuning the antenna. Any closer to the ground or setting the antenna on anything made of metal like a roof of a car will likely interfere with tuning. See Fig. 7, tuning the dipole on the three element beam off the ground.

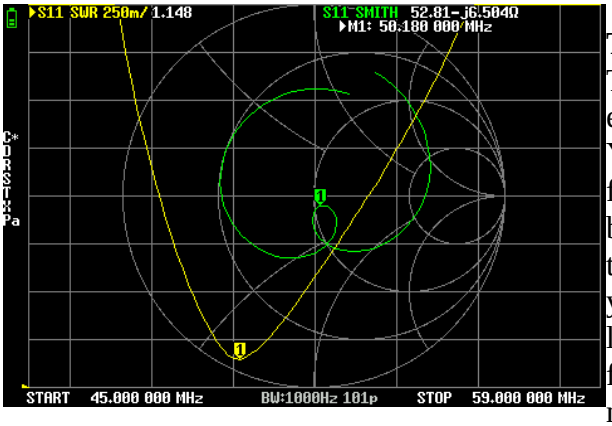


If you are tuning for the two or three element beam, do not tape any wire to the reflector or directors yet. Using an antenna or a VNA analyzer, tune your dipole by snipping small lengths of wire on each side until your antenna is almost in tune. Start off taking cuts around 1/2” or so. After every few cuts, measure from the edge of the conduit to the end of each side of your dipole to ensure that both sides are the same length. As you get closer on a 6 meter antenna, take very small cuts (1/8”) as you get close to your desired frequency. If you are building a simple dipole and cut too much off and your antenna resonates a little higher than your design frequency, you may need to lengthen your wires or start over with longer ones. If you are building the 2 or 3 element antenna and went slightly too short - no worries - that will be corrected with a second tuning process.

If you are going with the simple dipole, you have completed the tuning process. The best match for the dipole will be around 1:1.2 SWR. You could add a hairpin match to get a near perfect SWR, but we’re keeping this as simple (and as rugged) as possible.

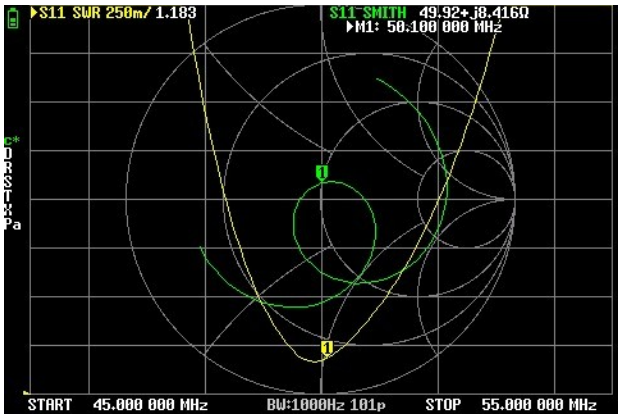
For the two or three element beams:
Take the total length of your dipole - end to end and multiply that by 1.05. That will be the minimum length of your reflector wire. Center that wire and tape it to the rebar that is to be used for your reflector. You will notice that the your tune has changed! Your resonant frequency will drop around 1 Mhz lower. If you are building a three element beam, skip to “Tuning the three element beam” and do not trim the driven element. Else go on as follows.

Tuning the two element beam:
Carefully trim the driven element as before until your antenna is back at your desired frequency. You should be able to get it close to a low swr to around 1:1.15. See Fig. 8. Go to ‘Finishing Up’.



Tuning the three element beam:
Tuning this antenna is not done by trimming the driven element, but by trimming the director!
You should have tuned the dipole to your desired frequency and added the reflector. As with the 2-meter beam, the frequency of this antenna should be lower than desired after adding the reflector. Cut the length of your new director wire to be about 5% shorter than the length of your tuned dipole. Center that onto the rebar for the director and tape it down. Tip: Do not start off by making the director the same length as the dipole - it will not resonate at all until it is cut shorter than the dipole!

Carefully trim the director equally on both sides until the antenna is tuned. There will be a point where trimming the director has less and less impact on the tuning. The antenna will be very close to being tuned when the director is around 10% shorter than the driven element. If your director is about to be cut 10% shorter than the driven element but you are still just a few khz lower than your design frequency, stop trimming the director. You can finish trimming by taking one **very small** cut off of the driven element dipole. Do not take more than 1/8" and stop there. *Taking any more from the dipole will raise the resonant frequency very rapidly.* You should then be right at your design frequency. I was able to get a SWR of around 1:1.18 See Fig. 9.



Finishing up:
The last part is tying cords to ensure that the antenna hangs level and does not tilt. About not cutting the rebar - the driven element at the low end of six meters will be about 5 inches away from the end of a 10 foot rebar. A #4 hose clamp will be fastened at the end of the driven element rebar to hold the paracord to keep the antenna from tilting from side to side. That spacing is necessary to keep the metal hose clamp from affecting the tune and also electrically isolate the paracord from the dipole wire should the paracord get wet from rain, etc. The wire on the reflector is too long and the clamp could interfere so that is why the extra length or space on the driven element rebar is needed.

Secure the coaxial cable with tape so it drops directly from the antenna's center of gravity, There you will drill a small vertical hole. Run the center support paracord through this hole to the carabiner to keep the conduit from sagging in the middle. That cord will also need to support all the weight of the coaxial cable. Leave at least a 2-foot paracord "tail" below the center hole as a strain relief for the coax. This ensures the heavy coaxial cable does not pull on the dipole wires or bend the conduit over time. Perform a 'hang test' as shown with Fig. 10. That photo does not show the center cord, but one was added later.

Tape all connections and seal the back end of the SO-239 connector if possible. If painting, **never use metallic paint** anywhere on an antenna, and avoid spraying a heavy coat of black paint on the wire as black paint may contain carbon that could affect tune. A light spray paint on the wire did not affect anything.

Operating: I am using these beams with about 150' of lmr-400 equivalent type coax and have no RF issues operating them at 100 watts. I am not using any type of a choke. A choke may be necessary for shorter runs of coax.

One thing I noticed is that these beams are very quiet. Never having used a beam before, at first I thought they were not sensitive and that they did not work. Just the opposite! The dipole I first used was very noisy and reception was fair. Using even just the two element beams, the noise floor drops significantly and signals received are considerably stronger - a double win!

Notes:

Important! Some batches or brands of fiberglass rebar can be more ‘prickly’ than others. When handling a new rebar with bare hands, I would occasionally get a tiny splinter. One manufacturer makes red ones but the green bars made by GreenBar seem to be almost splinter free. Still, consider wearing gloves when you get them and avoid sliding bare hands on them. Lightly ‘sand’ them down with a scotchbrite pad, clean with denatured alcohol and then spray them with a clearcoat finish to seal them. Clearcote is RF friendly. They have been splinter free for me after doing that, but repeating a light sand and spray might be necessary if you got a rough one. Stick a piece of electrical or ‘gorilla’ tape on your hands a few times in a row to remove a splinter if you get one.

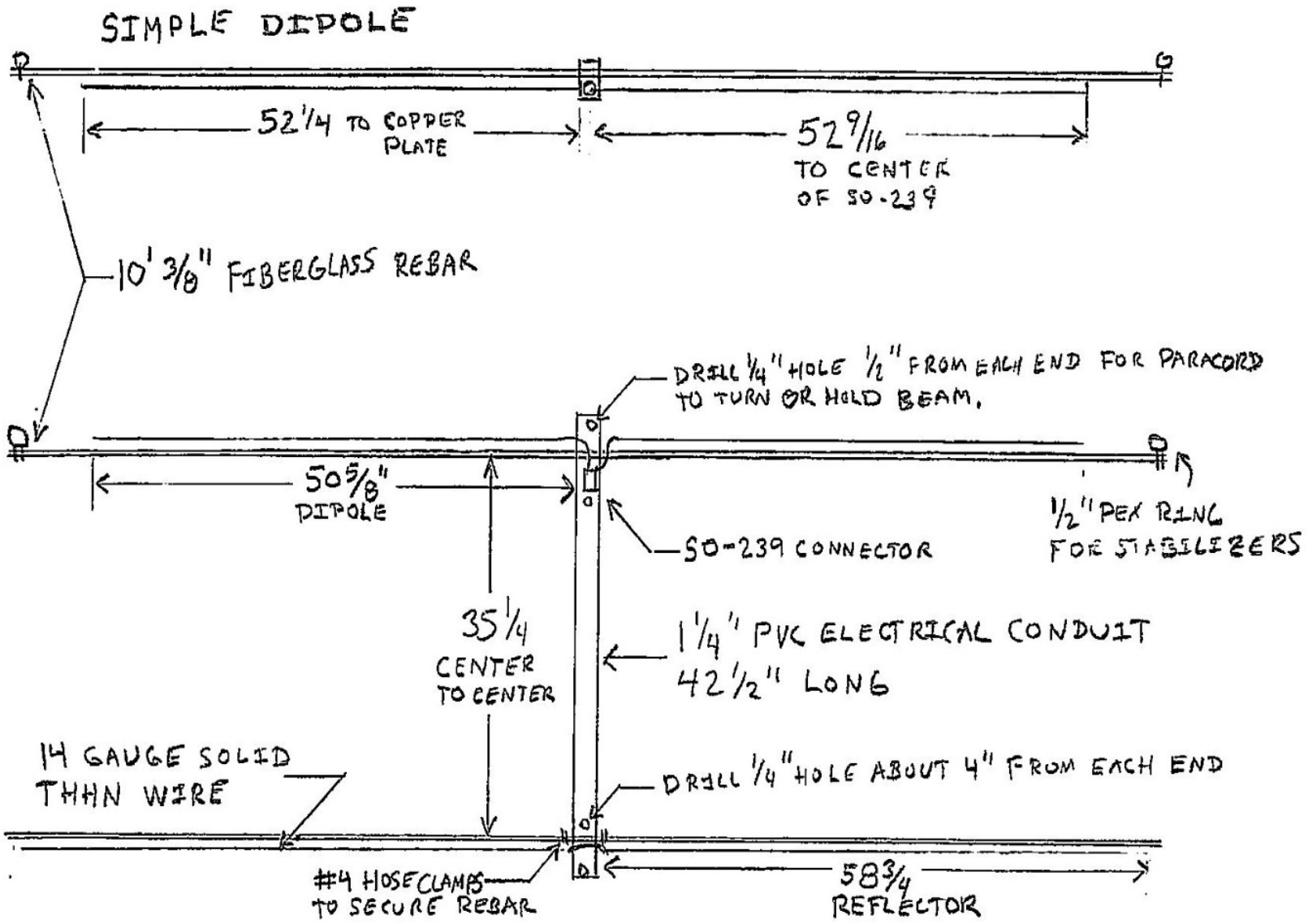
The antenna is very tough. Being in a tree, branches have fallen on my two-element beam and the fiberglass just bends and flexes back like a fishing pole - and they hold their tune.

Fold up beams! For field day or POTA, consider taping down the wire on just one side of the elements ‘permanently’ but leave just a few wraps of tape on the opposite side. Fold a small piece of tape onto itself to make a tab so you can easily unwrap it. That way you can quickly remove the tape to separate the wire from the rebar, loosen the hose clamps on that side and slide out the rebar from the conduit. When folded, the antenna then takes up little more space than the rebar itself. If you are using good quality tape, you can even stick the used pieces of tape to the conduit when in transit and reuse that.

Parts list:

Paracord - available any hardware store.
Carabiner (Get a stainless steel one for a semi-permanant installation outside)
10', 1 1/4" conduit - $14.26 https://www.homedepot.com/p/Cantex-1-1-4-in-x-10-ft-Gray-Non-Metallic-PVC-Schedule-40-Conduit-A52BC12H/202352527
3/8" 10' fiberglass reinforced plastic (FRP) rebar $6.42 each (Lowes)
https://www.lowes.com/pd/GREENBAR2X-3-8-IN-X-10FT-3-GFRP/5015645427
10 pack of #4 hose clamps - $12.98 (Home Depot) https://www.homedepot.com/p/Everbilt-5-16-5-8-in-Stainless-Steel-Hose-Clamp-10-Pack-626025E/202262868
SO-239 socket (3 for $9.99 on Amazon) https://www.amazon.com/MOOKEERF-Chassis-Adapter-Connector-Bulkhead/dp/B093DCG7NH
Use good quality electrical tape! (Scotch 33). Cheaper brands dry out, unwind and loosen
10-30’ of 14 gauge THHN sold wire (depending on the antenna built) - about $20/25’, $35/50’
1/2" PEX crimp rings 25 pack - $10.98 (optional) - Lowes or Home Depot
https://www.homedepot.com/p/Apollo-1-2-in-Copper-Crimp-Ring-25-Pack-APXCR1225PK/301541066
Your tower - a tall pine tree...

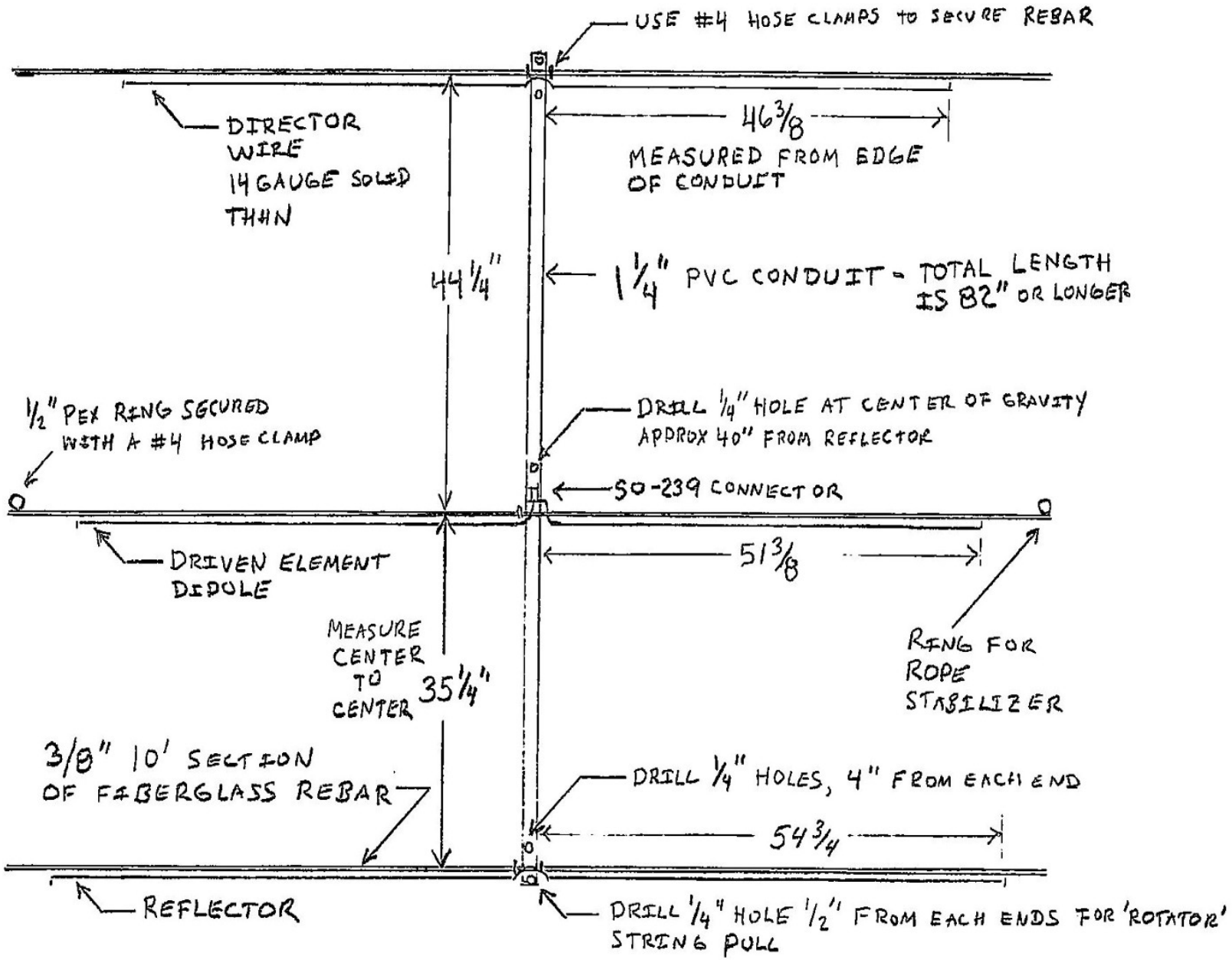
Captions:
Fig. 1 Dipole SO-239
Fig. 2 Copper Pex ring cord support
Fig. 3 Original dipole and budget beams
Fig. 4 Dipole and 2 Element Beam plans
Fig. 5 3 Element Beam plans
Fig. 6 SO-239 mount
Fig. 7 Tuning
Fig. 8 2-element Beam SWR
Fig. 9 3EBeam SWR
Fig 10 Hang Test
Fig.11 Author’s Stealth Beam



6 METER 2-ELEMENT BEAM ANTENNA

TUNED FOR 50.2 MHZ

SCALE 3/4"/1 FOOT



6 METER BEAM ANTENNA

3/4"=1/2' SCALE

JUNE 2026

TUNED FOR 50.2 MHZ - 3 ELEMENTS

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