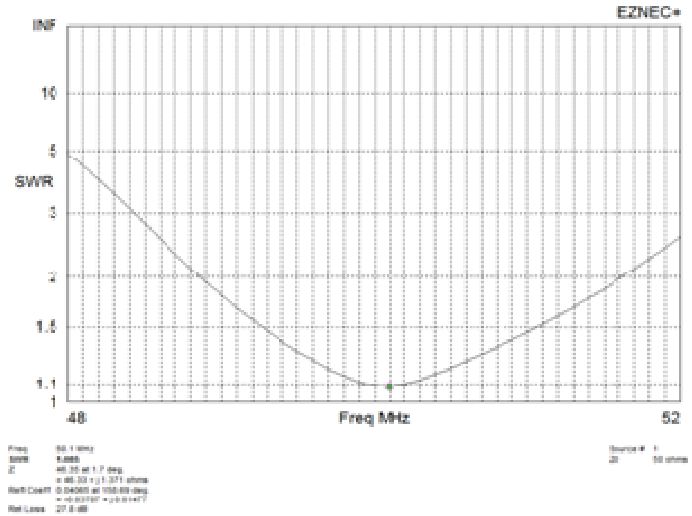
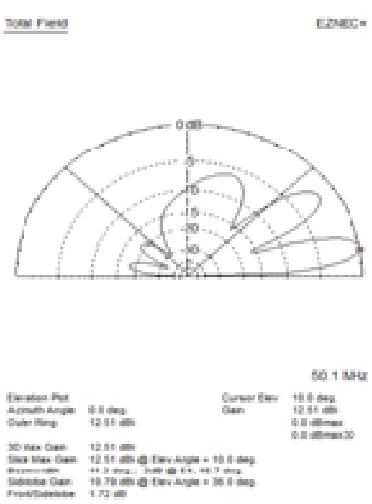
The Ultimate (i.e., Last) Cheap 6 m Yagi - An ACE Hardware Special 3 el Wire Antenna

Rather than do the easy thing and spend the $200 to get a commercial 3 el yagi that supports 500 watts, I have opted to have some fun and replace the prior not-so-old wire 2 el Bent "Yagi" with a 3 el wire (straight) yagi. This can be done with a single (well planned) trip to ACE Hardware and modest outlay of cash (plus items from the junk box).

First EZNEC was sent into action to design a 3 el unit (beginning with the ARRL Antenna Book 306_6 example) that can be feed directly with coax without any snooty matching (or power restrictions) components by selecting dimensions/spacing that lead to a nearly 50 ohm impedance at 50.1 MHz. This is not very difficult and it turns out that a practical 6' boom and approximately equal spacing can do the trick. The calculated main lobe gain is ~ 12.5dBi at 25' height. The model also shows good F/B but this part is not very useful on 6 meters.





The main construction issue with a wire element beam is, of course, support for the floppy wires. To handle this, a boom of 2"X 2" wood and three 10' lengths of 1/2" thin wall PVC pipe were used. The element wires are then attached along the PVC support pipes and the pipes are mounted perpendicular to the boom. These attachments, plus the one to the mast, uses several shorter lengths of the 2X2, screws and generous quantities of duct tape as shown in photos at the end.

You might well wonder if the use of the (dielectric) PVC pipe as supports could have some impact on the antenna tuning and performance. The answer seems to be yes to some modest degree but a proper comparison (with and without PVC supports) and evaluation was not practical.

The strategy in cutting/tuning the 3 antenna elements was:

1. Note the predicted wire lengths from EZNEC and plan to make the actual wire lengths in direct proportion to those from that model
2. In EZNEC, remove the reflector (REF) and director (DIR) elements from the final design. Then determine the minimum SWR frequency for the bare driven element (DE).
3. Starting with a generously long DE wire, put up the physical antenna with the DE only.
4. Trim (and/or fold back, which can be undone) the DE wire until it has the minimum SWR at about that same frequency from step 2 above.

5. Cut (and/or fold ends of) the physical REF and DIR wires to the same ratio to the trimmed DE as that ratio found in the EZNEC model.
6. Attach all 3 wire elements to the boom/PVC support and verify that the SWR is suitably low in the frequency region of the design.
7. If the frequency of the SWR minimum is farther from the design frequency than desired, you can change the length of the DE a bit without any significant impact on the gain.
8. Verify that the final antenna has some F/B and F/Side that resembles the EZNEC predictions to assure you really are getting some gain. Measuring gain is way outside the scope of this project.

Note that the standard of measurement here is SWR (at 50 ohms) rather than impedance (and it was done with the MFJ 259B). That is because the apparent impedance of an antenna as seen at the end of a coax feed line is transformed according to the length of the coax while the SWR is (nearly) independent of the coax length.

For this case, the tuning was carried at a height of 10' and at a different location from the final site. One issue that arises is that the minimum SWR (or resonance or impedance) for the DE changes with antenna height. You can (in an ideal world) compensate for this by using 10' as the height in Step 2 above.

With element spacing of 34” to the DIR and 38” to the REF, EZNEC and actual element half lengths found are

REF	DE	DIR		
59.3	56.9	52.4	inches	EZNEC
58.8	53.8	51.4	inches	Actual effective

Note that the actual DE is relatively shorter than the other elements since the frequency of minimum SWR proved to be rather lower than predicted and so it was moved up by shortening the DE as a final step. The final minimum SWR was 1.6 at 50.2 MHz at 10' height. When raised to the final 25' the minimum SWR became about 1.4 at 50.2 MHz. The effective dimensions above are estimated by adding 25% of the folded back length to the measured distance to the fold points based on prior rough fold back experiments.

Estimates were made of the pattern of the final antenna at 25' but it seems quite possible that there is a distortion due to the proximity of the garage roof – the antenna just peeks over the peak of that roof (a good neighbor stealth effort). Roughly speaking the F/B is ~ 15 dB from the S-meter and the F/Side is ~ 20 dB but the front lobe seems to be shifted off axis somewhat for measurements in the only emitter direction I could easily manage.

The assembled antenna (with coax coil “balun”)

Mast attachment, feed point and DE support (yellow part is a saw horse).

End view (note use of a split-off 2X2 corner to make a clamp) showing plenty of duct tape.

A folded end attached with tape and cable tie.

Support for the REF PVC pipe. Note the dowel above the pipe used to take up space. Also note the 2 screw holes as well to hold the PVC pipe perpendicular to the boom and level.

End view

Screw to fine tune DE leveling