6 Meter Band MOXON-STYLE
TWO-ELEMENT PARASITIC BEAM ANTENNA
By K8JHR

OBJECTIVE:

Design and build a 6 meter 2-element Moxon antenna mostly from available aluminum tubing and angle stock.

THE MOXON ADVANTAGE:

A Moxon beam can be expected to provide approximately 5.5 dBi forward gain; the advantage being moderate forward gain, with reduced rear gain, and nulls off both sides. The active element is a half-wave dipole, and the parasitic element is approximately 9 % larger (or smaller) than the active element. If larger, it acts as a reflector, and if smaller, a director. It is easy to feed, as it is simply a dipole with a parasitic element mounted nearby. A Moxon beam has a smaller footprint than some other beam designs, while providing nearly the same gain and front-to-back ratio, as a typical two-element Yagi beam.

The folded elements are joined with PVC spacers, which provides greater strength, unity and wind-handling, compared to the typical two-element Yagi beam. Because the ends of the elements are folded toward each other at a 90 degree angle, the wingspan of a Moxon style beam is approximately 25% shorter than that of a Yagi beam. Moreover, feed point impedance is inherently close to 50 ohms, which obviates the need for a separate matching network. 2:1 SWR bandwidth is expected (i.e., claimed by some) to be as good, or better, than that of a typical two-element Yagi. Some (e.g., MFJ, ARRL Antenna Book) claim it has a 30 dB front-to-back ratio... but others, including SM5JAB suggest this is only when the design is modeled in free space, and its actual performance is much lower once it is installed over real ground, in a real environment where it will couple and react with other "stuff" in its environment. Therefore, a realistic expectation is more like 5.5 dBi gain, with 18-20 dB front-to-back ratio, which is sufficient to justify the effort.

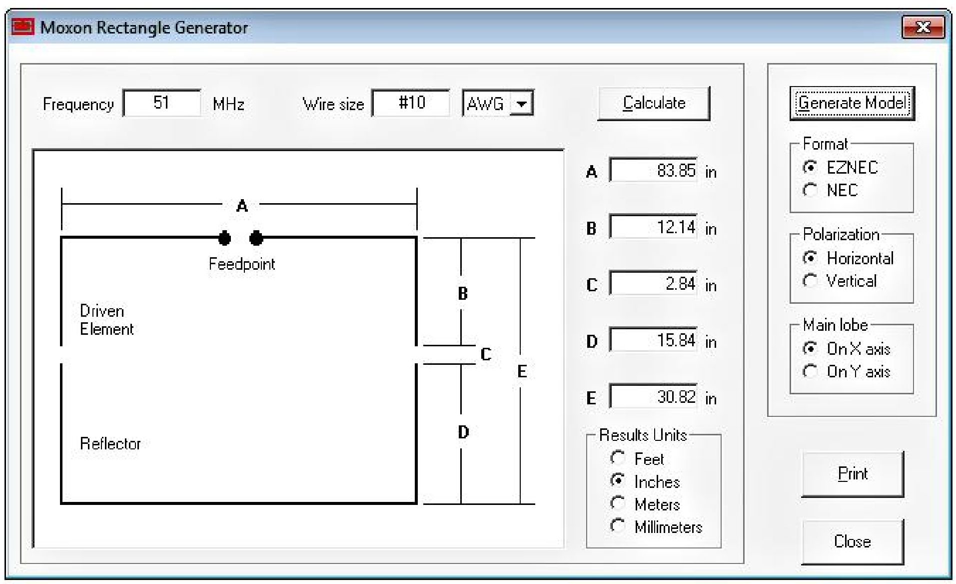
The key factor in the design, is the space or distance between the ends of the two parasitic elements, which are bent 90 degrees, and aligned so they face and point to each other. The two elements provide capacitive loading-coupling, which may be preferred to inductive loading. This capacitance is governed, at least in major part, by the distance or spacing between the elements. Tuning the antenna involves adjusting the spacing between elements, as well as the length of the elements, themselves. SM5JAB says, "The length of the reflector, while important, is better left identically the same as the driven element, and then tuned for best F/B-ratio."

One can mount a Moxon beam either horizontally or vertically, and is vertically polarized if mounted vertically, and is horizontally polarized if mounted horizontally. One might benefit from a 1:1 “balun-choke” to squelch undesirable common mode current (CMC) made from ferrite beads surrounding the coaxial cable transmission line, or from wire wound on a toroid core,   or from a choke made from a closely spaced coil of four to six turns of turns of coaxial transmission line formed around a 5 inch form. This latter type of common mode choke is often referred to in the vernacular as an “ugly balun.”

CONSTRUCTION:

I build antennas from aluminum tubing and aluminum angle stock, because it is light weight, easy to manipulate, resists corrosion, and is a good electrical conductor which should radiate well. I computed the dimensions of my Moxon beam using a free computer application called MoxGen, which is, in turn, based upon an algorithm developed by Professor L. B. Cebik, W4RNL (SK.)   This freeware can be downloaded at: http://www.ac6la.com/moxgen1.html

The following illustration depicts the application input and output which determined the initial dimensions of my Moxon beam.   A six meter Moxon made according to these figures forms a rectangle approximately 83 inches long, by 30 inches wide.



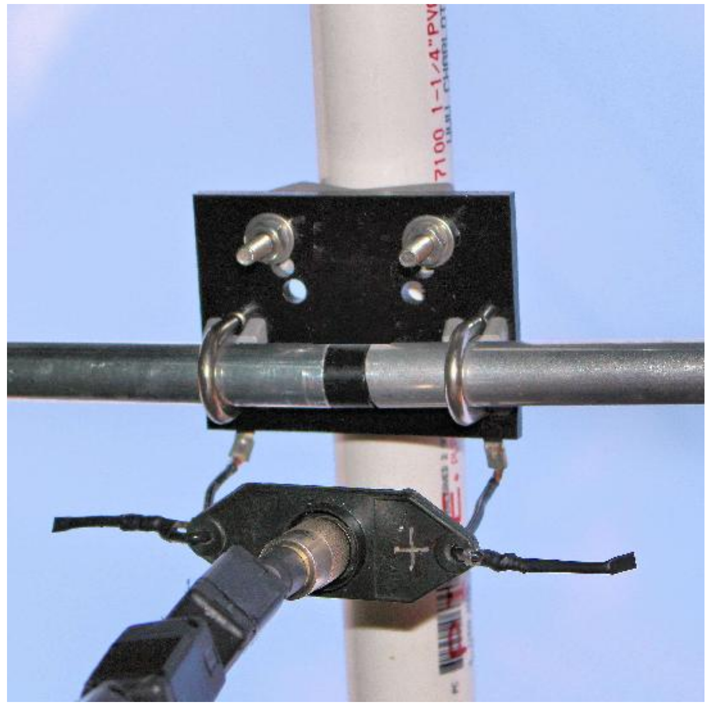
INSTALLATION:

I mounted my 6 meter Moxon beam on an inexpensive TV style antenna rotator, which is, in turn, mounted on a 30 foot Rohn galvanized steel push-up mast.   The rotating mast is made of an 18 inch piece f 1.25 galvanized TV mast, which I kept rather short to minimize torque and stress from strong wind.   A larger Moxon beam might require a larger, more robust rotator, but this should suffice for my light weight 6 meter Moxon beam which I guesstimate weighs less than 10 pounds.

At the end of this report, I include a pair of charts listing and identifying parts one can use to build a 6 meter Moxon beam like mine. Notwithstanding, I mostly used whatever materials I had on hand, so my final project may not include exactly every part listed therein.   Your mileage may vary, but I include the charts more as a suggestion than a recipe.

The active element is a dipole made from 3/4 inch aluminum tubing, with a polymer spacer in between.   DX-Engineering sells these split spacer/insulators for $6.95, which may seem a bit pricey, but they work slick in both reinforcing the aluminum elements and separating them about 3/4 inch to serve as separate dipole elements.

I used a Budwig HQ-1 dipole center insulator which is super strong and weather proof. It provides a SO-239 coaxial cable connector, and two copper terminals for connecting a transmission line to the dipole elements. I added a pair of ring lugs to the copper terminals and attached them to the saddle clamps holding the dipole elements. This made it very easy to assemble in the field.



I made an element-to-boom plate from three galvanized steel fence mending plates purchased for less than a dollar each at the hardware store. Stacking three of these on each other made the resulting plate very strong for very little expense. Inexpensive U-bolts from the hardware store and small nuts and ny-lock washer nuts secure the elements to the plate.

I recommend stainless steel nuts and bolts, U-bolts, and other hardware if possible, but I admit to using some zinc plated U-bolts I had on hand because I was too lazy and cheap to run to the hardware store and get the good stuff. I don’t expect this to be up for many years, so I went with what I had on hand. Your mileage may vary.

I made a boom-to-mast plate from an inexpensive piece of fence mending plate purchased at the local hardware store for $3.00 One might stack two of these together for added strength, but this seemed adequate for a 6 meter antenna - I would likely double it up for a 10 meter example.   I used a mixture of stainless steel and zinc plated U-bolts I had on hand, but one might do better to use DX-Engineering V-bolt saddle clamps (see top claim in photo to the right, and photo insert, below) as these are extremely robust, and the saddle grips the mast so that it is less likely to twist or shift in a strong wind.

I used an inexpensive RCA TV rotator and a 1.5 foot long section of 1.25 inch diameter galvanized television antenna mast I had on hand. It was just long enough to raise the antenna above the rotator, but not allow too much torque in case of strong wind.

I ran 3-conductor rotator control wire from the base of the unit to the controller in the shack.

I tuned it at this height. The deck railing is approximately 9 feet above the turf. Ultimately, I will raise it another ten feet after I finish tuning and pruning it.

It seems to be easier to adjust and tune the lowest SWR frequency by altering the length of the longer elements, rather than altering the length of the shorter bits that point at each other, or by changing the capacitive distance between ends.

I think we tuned this in pretty well... at least so far... maybe I can improve it higher in the band, but I think this will do for starters . . .

At right, is an image of what my MINI60 (SARK100) antenna had to say about impedance and SWR.

Below, is an image of what my RigExpert AA-230 antenna analyzer had this to say about impedance and SWR.

CONCLUSION:

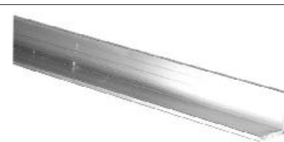
My Moxon beam appears to be well measured and installed so that it presents a nearly 50 ohm feed point impedance, and a low 1.5 :1 SWR, across the most useful portion of the 6 Meter amateur band. It seems mechanically and electrically sound, and should provide good service, with an expected gain of approximately 5.5 dBi, and should outperform my previous 6 Meter aluminum dipole.

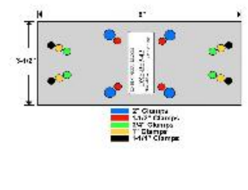
James - K8JHR

Appendix 1. Theoretical Comparison - Moxon vs Yagi.

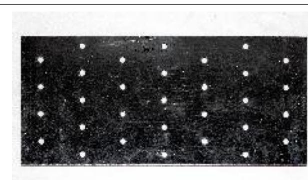
MOXON	YAGI
2 Element Parasitic Beam Antenna	2 Element Parasitic Beam Antenna
Approx . 5.5.dBi Gain	Approx . 5.5.dBi Gain
Shorter wingspan - lower wind loading (approx 83 inches)	Wider Wingspan - higher wind loading (approx 117 inches)
Unified construction -elements connected so entire antenna is a single unit	Less unified construction - elements are connected only at the center, with no support for the individual elements
Wider low SWR bandwidth (in theory)	Narrower low SWR bandwidth (in theory)
Wider beam width (in theory)	Narrower beam width (in theory)
Higher front-to-back gain (in theory)	Less front-to-back gain (in theory)
Same weight as a Yagi	Same weight as a Moxon
Inherently 50 ohm match - no need for a separate matching component when using 50 ohm transmission line (i.e., IF carefully constructed and properly aligned, tuned, pruned, etc.)	Not necessarily a 50 ohm match - typically (although not always) requires a a separate matching component when using 50 ohm transmission line
Has a more exotic "cool factor" - (in theory) OK... just poking some fun and seeing if anyone will ever actually read this report...) ;-)	Ordinary, commonplace, no "cool factor"
Fussy to construct - more hardware and dimensions are fairly critical to achieve expected results	Less fussy to construct - less hardware to assemble and dimensions are more forgiving and less critical to achieve expected results - use a matching component, such as a gamma match or hairpin matching network to tune and match to 50 ohm coaxial transmission cable - easier to achieve expected results by adjusting the matching network, rather than futzing with the length and spacing of the various pieces of the Moxon design.

APPENDIX 2.   SUGGESTED COMPONENTS, LIST NO. 1.

uant.	Part No.	Description	Image	@ Cost	Total Cost
1	DXE-AT1499	1.25” diameter aluminum tube		$3.25	$3.25
2	DXE-AT1482	3/4” (.750”) diameter aluminum tubing		$5.35	$10.70
2	DXE-BEB-3	Polymer Element to Mast Plate (approx 3” x 4” x 1/4”)		$4.95	$9.90
2		Aluminum Trim Channel 3/4” x 3/4” x 8 ft		$7.27	$14.54
1		3 ft aluminum angle stock		$3.50	$3.50
4	DXE-SAD-075A -	3/4” (.75”) Saddle Clamp		$6.45	$25.80
2	DXE-SSVC-150P	1” – 1.5 “ V-Bolt saddle clamp		$9.95	$19.90
	DXE-MMP-P2	7.5” X 11.5” multi purpose mounting plate		$7.45	$7.45

1	DXE-SEI-1	Split Element Insulators		$6.95	$6.95
1	DXE-BEP-5B	Alternative: DX Engineering Antenna element-to-boom plate - Aluminum, Pre-Drilled For 3 in. Max. Clamps, 0.25 in. Thick, 3.5 in. Width, 8 in. Length, Each		$20.45	$20.45
1		Budwig HQ-1 Dipole Center Insulator and Coax Connector (SO-139)		$10.00	$10.00
			ANTENNA ONLY	SUBTOTAL	$132.44
1	HGN-AR-303	RCA ALight Duty Rotator and Controller Combo		$64.95	$64.00
55	DXE-CW8	Rotator control cable		$.50	$5.55
1		5” x 9” (approx) galvanized metal mending plate (as boom-to-mast plate)		$3.00	$3.00
		30 ft Rohn Galvanized Steel Mast		$120.00	$121.00
			Complete Project	TOTAL:	570.94

APPENDIX 3. SUGGESTED COMPONENTS, LIST NO. 2.
(Closer to actual project build than List No. 1.)

Quant.	Part No.	Description	Image	@ Cost	Total Cost
1		1.25” diameter galvanized mast / tube or fence post top rail		$10.00	$10.00
2		Aluminum Trim Channel 3/4” x 3/4” x 8 ft		$7.27	$14.54
1		3 ft aluminum angle stock		$3.50	$3.50
3		3” x 7” galvanized steel mending plate (stack 3 together to form one element-to-boom mounting plate)		$ .84	$2.52
2	DXE-SSVC-150P	1” – 1.5 “ V-Bolt saddle clamp		$9.95	$19.90
2	DXE-MMP-P2	Polymer Element to Mast Plate (approx 3” x 4” x 1/4”)		$4.95	$4.95
1		Budwig HQ-1 Dipole Center Insulator and Coax Connector (SO-139)		$10.00	$10.00
			ANTENNA ONLY	SUBTOTAL	$65.41

1	HGN-AR-303	RCA Light Duty Rotator and Controller Combo		$64.00	$64.00
55	DXE-CW8	Rotator control cable		$.50	$5.55
1		5" x 9" (approx) galvanized metal mending plate (as boom-to-mast plate)		$3.00	$3.00
1		30 ft Rohn Galvanized Steel Mast		$120.00	$120.00
			Complete Project	SUBTOTAL:	257.96