HOMEMADE UMBRELLA HEXAGONAL BEAM

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I enjoy working portable QRP, but I have never been satisfied with my portable antennas. I have a Leo Shoemaker KIO hexagonal beam at my home QTH that never ceases to amaze me. One day the thought hit me of how great it would be to have a portable hexagonal beam that would be easy to carry and deploy. At that point I became determined to construct a portable hexagonal beam that I would be able to carry in a tent pole bag along with 100 feet of RG-8X coax.

The first photo shows all of the components for my portable hexagonal beam minus the mast stand and guy cord stakes. The components starting at the top are fiberglass mast, six spreaders, hub, tent peg bag for smaller components, blue 17M element holder, orange 20M element holder, two guy rings with cord and the tent pole bag which holds all of the other components. The second photo shows the components that I store in the small tent peg bad which also fits in the tent pole bag.

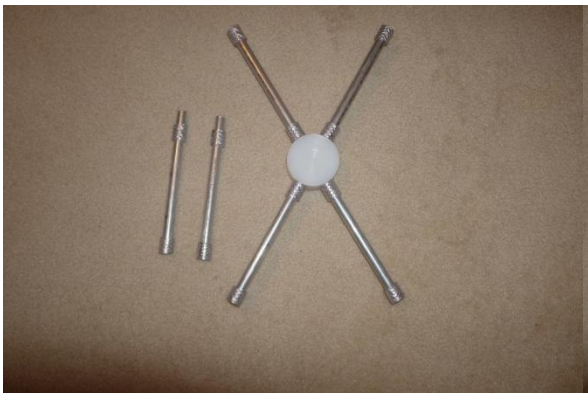
Portable Hexagonal Beam Smaller Components with Storage Bag

Portable Umbrella Hexagonal Beam Construction

I decided to not use the conventional hexagonal beam design which has spreaders that turn up and requires a center post with terminals for connecting the various elements. I wanted to let gravity work for me and not against me and let the

spreaders drop at the tips due to the weight of the poles and wire elements. The overall look is like an umbrella without the cloth covering. This design offers an advantage when using a relatively large diameter antenna on a small portable telescopic mast. It is the sameprinciple as tight rope walker using a long pole drooping on each end to lower the center of gravity. The compromise is that you do loose some height with the antenna elements being lower than the hub as opposed to being higher above ground on the conventional hexagonal beam on a mast of the same height.

The first component that I designed was a hub that could be used to support the six telescopic Shakespeare fishing poles that I decided to use as spreaders. These poles are readily available on line from the Shakespeare web site. After several design changes I ended up with the hub shown in the two photos below.



Hub with Two Tubes Removed

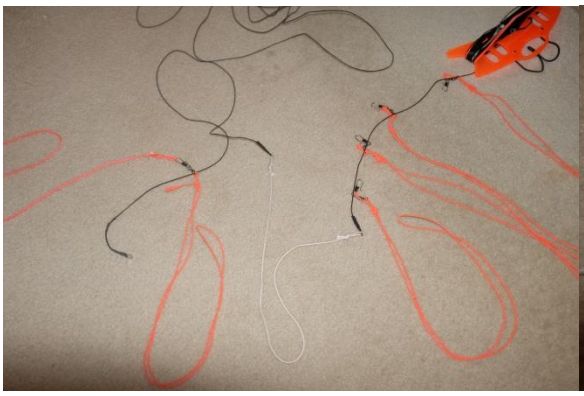
Assembled Hub

I first looked at hubs made from PVC pipe parts that anyone could purchase. It turned out that these designs were not strong enough to support the antenna spreader or were too heavy. Fortunately I have a machine shop at my house and had a means of fabricating the hub. The center of the hub is made from HDMW plastic with holes bored at every 60 degrees around the perimeter. I have a rotary index table that I set up on my milling machine to make this hole boring operation relatively simple. I looked at several materials for the supports that are mounted in the six hub holes. I settled on 7 inch long ½ inch diameter aluminum tubing with a 1/8 inch wall thickness. The aluminum tubes are pushed by hand into the ½ inch bored holes and are secured by a tight fit. In order to provide a good fit with fishing poles inside diameter I glued two spacers on each of the

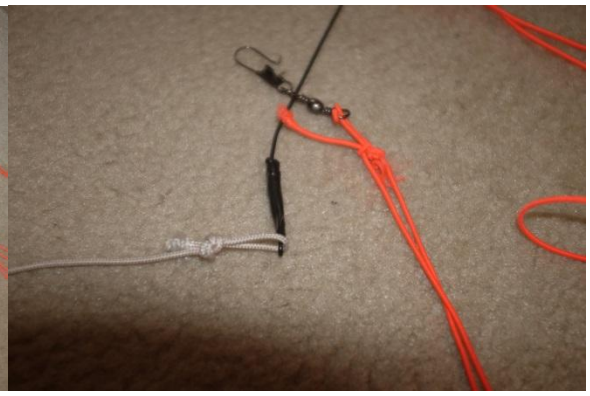
aluminum tubes. The beauty of the telescopic poles is that they collapse to a short length for transporting, they are relative light and strong and they have a removable end cap that allows you to slide them over the hub tubes.

My hub has a hole bored in it that allows a friction fit on the top of a 25 foot 7 inch telescopic fiberglass mast. The mast was originally 32 feet long, but I removed the last two sections that were too small to provide adequate stability for the antenna.

Thanks to Leo's *Build Your Own Hexagonal Beam*web site, I was able to use his insulated wire and spacer dimensions as a starting point for designing the wire elements for my hexagonal beam. The bands that I enjoy for portable ops are 20M and 17M. I fabricated my wire elements for these two band using 26 AWG copper clad steel wire. This wire packs into a small space, does not stretch and is good for 100 watts. I prefer 5 watts! There are spacers required between the reflector and the driver halves. For the spacers I used small diameter parachute cord with a loop tied on each end. Refer to photos below.



Director on Left Connected to Spacer



Detail of Swivel for Supporting 20M Elements

I decided to use the wire eyes on the end of the fishing poles to support my 20M element. This element is attached to the end of each rod using a fishing swivel. For attaching the 17M element I attached a loop of elastic cord that I am able to use to support the small diameter 17 M element. Twelve foot long fishing poles turned out to be the length that I needed. These poles are a little short, but this causes the ends of the poles to turn down and provide a spring like action to keep the wire elements tight.

The end of each of the two driver element has a ring terminal that is crimped, soldered and covered with heat shrink for added strength. The ends of the driver terminals are attached to a connector assembly that slides over the mast. I used a piece of old inter tube that is attached in a loop to the two binding posts mounted on a piece of plastic. Refer to the photos below.

Back View of Element Connector Front View of Element Connector

Deploying the Portable Umbrella Hexagonal Beam

The following is my step by step procedure for deploying my antenna:

- The first step is to find an area that is large enough to not interfere with the size of the fully erected hexagonal beam that is about 24 feet in diameter.
- After selecting a location I use a metal base plate type mast support that can be staked to the ground for supporting the mast during assembly.
- I use two plastic guy rings that I purchased from DX Engineering. These slip over the top of the mast. I use one that is located a couple of sections from the top of the mast and another one that is about half way between the top guy ring and the ground. The guy rings come in sets with various center hole diameters. You select the guy ring that is the right size to slide down and stop at the mast section that is too large for it to pass over.
- Next tie three nylon cords to each of the guy rings that are long enough to reach three stakes at equal spacing around the mast. I set my stakes at about 8 feet from the mast. These stakes need to be substantial because of the loads that they can experience if a wind sneaks up on you at the wrong time! I use 18 inch long Magellan Outdoors Heavy Duty Stakes. I

purchased mine at Academy sports. You will also need something to drive the stakes in the ground. I use a plastic mallet.

- Extend the mast to the full length using the mast stand and attach the guy cords to your stakes. *Do this step before you mount the antenna.* The guy cords need the slack removed, but they do not need to be pulled super tight. You may even want to use a level on the mast to help you adjust the mast to true vertical position. Lower the mast and keep the guy cords from tangling.
- Pull up the end section of the mast and slide the wire terminal assembly over the mast.
- Mount the hub on the top section of the mast. This needs to be a tight friction fit. You do not want the antenna hub spinning on the mast when you get a gust of wind. If the hub does not fit tight, a piece of electrical tape wrapped over the top of the mast can be used to shim the hub for a tighter fit.
- Remove the end plugs and bottom caps from the six poles and slide them over them hub tubes. I recommend a twisting motion when you slide the poles over the tubes. This may be a tight fit. Liquid soap can be used as a lubricant if necessary.
- Extend the poles, but leave the last couple of sections loose. This makes assembly much easier. The pole sections are a friction fit just like the mast.
- Connect one of the drivers to the antenna terminal connection that you previously slid over the mast and then proceed to connect the driver and reflector elements to the rod tips using the fishing swivels. I fabricated my elements so that the swivels and elastic cords for 17M remain installed on my 20M element during storage. Finish by connecting the last driver connector to the other terminal connector.
- Next extend all of the fishing poles to full length. You will notice that the rod tips are pulled down. You will next need to connect a piece of nylon cord between the two poles where the driven elements are run to the terminal connections. Tie one end to one pole tip swivel and then pull the cord around the other pole tip until the tips are pulled together so that

they are equally spaced like all of the other rod tips. I tied a knot in the cord at the proper length for a marker to make installation simpler in the future.

- At this point the rod tips might not be pointing straight down toward the ground. You can slide the rod tips and swivels along the element wire in order to move them to the point where they are pointed straight down.
- Connect the coax and slide the terminal strip down the mast where it is level with the rod tips.
- Slowly raise the mast making sure that you keep an eye on the antenna so that it does not lean too far in any one direction until the mast is extended to the point where the guy cords are supporting the mast in an upright position. When you extend each section of the mast, make sure that you pull and twist each section for a good tight friction fit. If you do not do this and a section of the mast slips, the entire mast will start collapsing down to the ground. This is not good for you or the antenna!
- My antenna system uses the "Armstrong" rotor system. You grab the antenna mast and rotate it by hand to the desired direction. The mast slips around in the guy rings with no problem. The end of the antenna that you point is the location between the two poles where you tied the cord between the rod tips. The cord that I use is bright orange. This helps me see this location when the antenna is at the deployed height. You can also tie a piece of cord or flag like material that hangs down from the cord to make it easier to see.

Conclusions

I have really enjoyed using this antenna for QRP portable operation. The antenna has about 4 dBd of gain. With this antenna and good lower loss coax you could end up with 6dB total gain over a lesser antenna system. This is one S unit. This means that it would take a transmitter with 4 times more power with a lesser antenna system to match this performance. If you were using this antenna at 100 watts, you would need an amp with 400 watt of power output to match the

performance with the lesser antenna system. When working QRP, 5 watts, four times more radiated power is a good thing!

Final Comments

The description above is my design for an umbrella hexagonal beam. I often get questions from people asking why did you do that, why don't you do this, I would have done this and that, etc. It seems like the majority of the people that I hear this from have never even built anything. I am happy to answer these questions, but this is the design that satisfies my needs. Please feel free to try your own design and make your own changes. Ham radio was meant to encourage experimentation. Have fun experimenting and you never know what brilliant design you might develop.

W4DML Working Portable QRP with Portable Umbrella Hexagonal Beam Photo by Joe Marler, KQ1Q

Additional Sources of Information

1. Build Your Own Hexagonal Beam, Leo Shoemaker
   http://www.hex-beam.com/

2. G3TXQ, Understanding the Hex
   Beamhttp://www.karinya.net/g3txq/hexbeam/