Understanding Antenna Directivity

-- Don't buy, build your stuff --

Gloss over talk →10 minute talk time limit

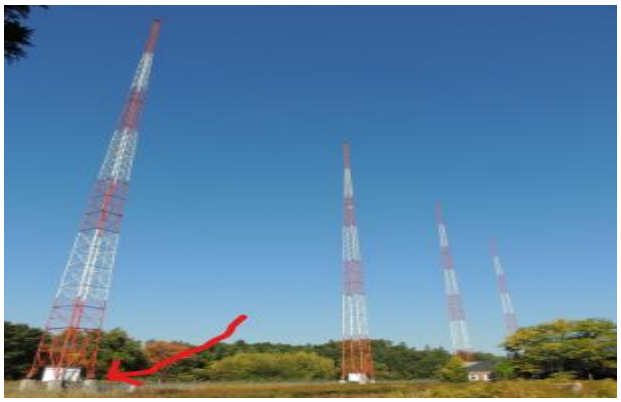
- Many questions asked at Donn's location were only half answered because of time and workload.
- → **Today is mainly about the questions asked that day**.
- In the short time we have today, we will try to provide additional answers. This will only be a gloss over - more time is needed for an in-depth discussion.
- At Donn's, more problems existed than just the antenna. Total was 4 problems. Three (3) additional issues existed inside the shack. One was software, another was hardware and also operator settings of antenna inside of shack.

Let's get started → What are directional antennas (aka beams)?

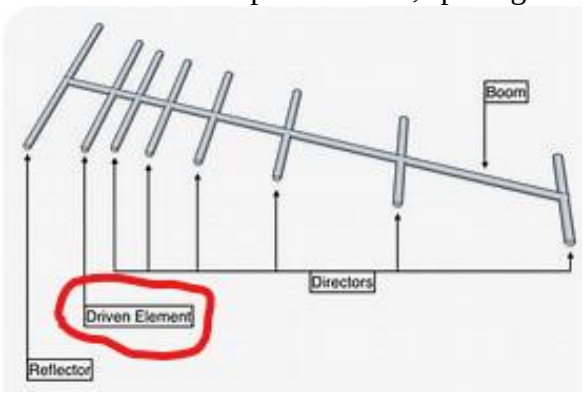
- Two types of controlling angle of radiation: Vertical & Horizontal. Both are equally important for performance.
- Today we speak about Horizontal angle of radiation - **Not** to be confused with Vertical & Horizontal polarization.
- What is the difference between parasitic and active phased elements?
- Definitions: What is a Mast, Boom, Parasitic Element, Driven Element, Gain, **F/B** ratio, **dBi** vs **dBd** (***Beware*** *of the difference when buying your next antenna*)?
- Secret sauce to make your Yagi antenna a top performer.

Difference between Vertical & Horizontal angle of radiation. – Just give a visual at talk.

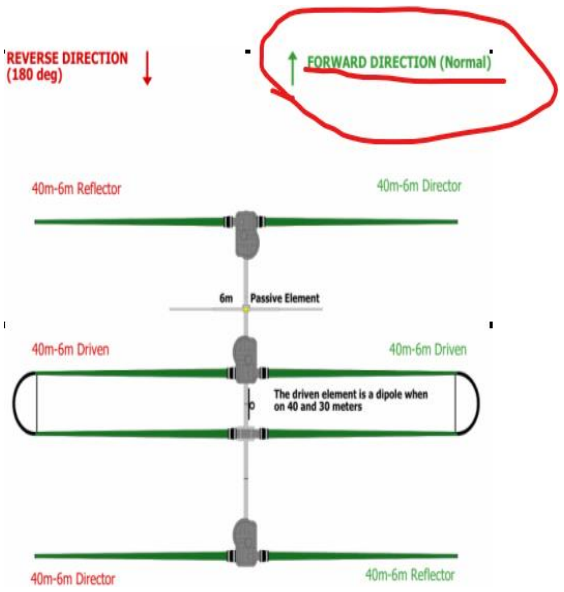
Active Phased Elements - Where all elements are driven or fed. See example below. AMbroadcast stations and hams. Towers are the antenna. Note insulators at base of towers. Change of directivity is accomplished by changing the driving phase to each tower. The picture on the right is called a 4-square antenna and is often used by hams on many bands. As little as two (2) vertical antennas are needed to enjoy control of direction. The phased vertical antennas could be wires up two trees. See articles in ***Treasure Coast Ham News*** archives on "home brewing" vertical antennas.

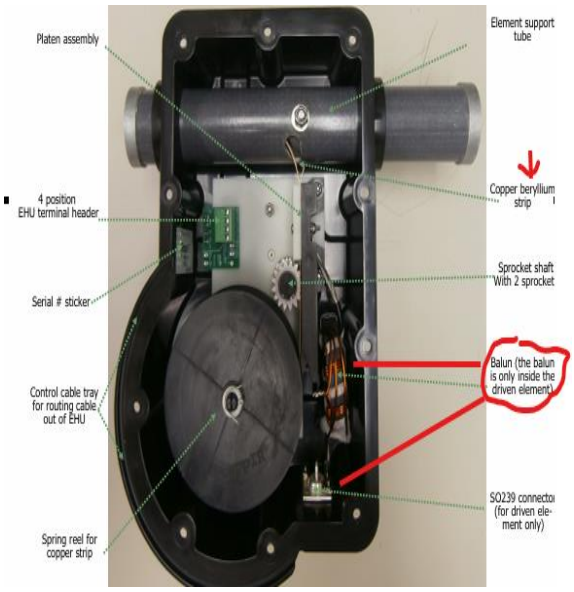


Parasitic element – Example below is an 8 element Yagi. Only one element is fed. The other 7 elements are called parasitic elements. This antenna has one reflector element, six director elements and one driven element. Note the spacing variations between the elements. For best performance, spacing needs to be changed for different bands.



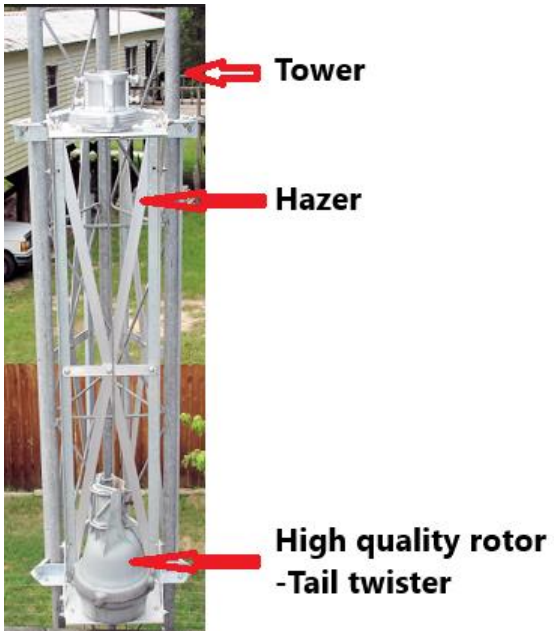
Example below is Donn's antenna - A 3 element Yagi. The trombone element is only to accommodate 30 and 40 meters. When operating those bands, the antenna operates only as a dipole antenna not as a directional Yagi. The director and reflector are with drawn and do not affect operation. Note – This antenna does not change spacing for each band, thus it's a compromise. Center element has a balun as it is the only driven element.





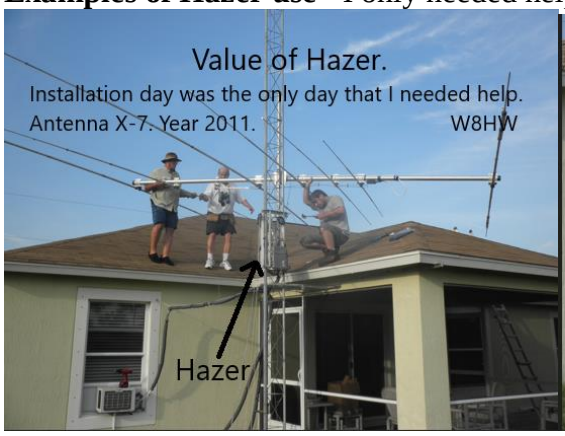
Example below is an antenna that does change spacing for each band.
Below is my 100 pound antenna. The longest element is just under 40 feet long.
It is a cross between **log-periodic array and Yagi,** providing the best of each**.** Only one element uses traps and that is the last director element. By doing this you only apply 2% of your power to the traps and gain an extra element for each band. The picture shows construction on the ground.

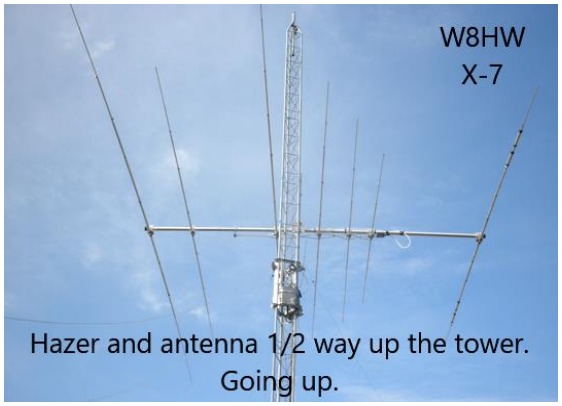
What is a Hazer? No need a crew to help with antenna repair. Just 1 person needed.

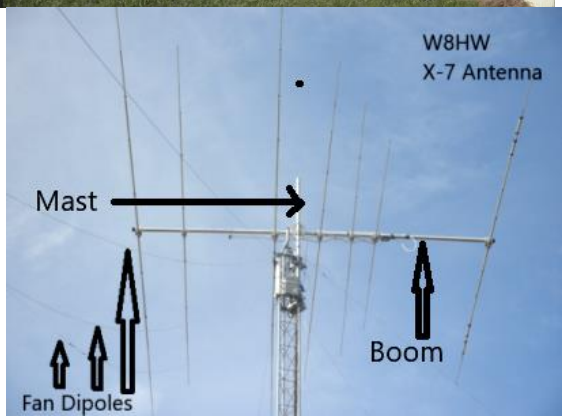


→ Consider a joint or club BIG station with strong DXing. Clubs spend money on repeaters that are not used much. Consider diverting some of that money to an HF club station. HF has activity 24 hours a day, making an HF station a good investment.

Examples of Hazer use - I only needed help one time… on the day of installation.







<u>A home brew 6 meter Yagi</u> - After construction, mounted on tower above the HF Yagi. Construction and gain measurements and adjustments made before putting on tower.

Beware→ The **difference between dBi and dBd** is as follows:

- Most antenna manufactures try to inflate gain ratings by using **dBi** instead of **dBd.**
- **dBi** (decibels relative to an isotropic radiator) measures gain of an antenna compared to an ideal isotropic antenna radiating equally in all directions.
- **dBd** (decibels relative to a dipole) measures the gain compared to a reference dipole antenna. A dipole antenna is defined to have a gain of **2.15 dBi**.
- Conversion between the two is: **dBi = dBd + 2.15**. If you know the **dBd** value you can easily convert it to **dBi** by adding **2.15**. Ex: **6 dBd** is the same as **8.15 dBi**.
- Understanding **dB**(everything) is valuable. Clubs should teach this.

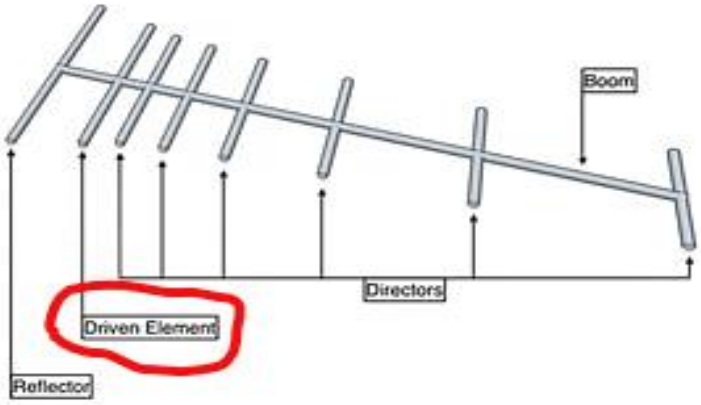
Secret sauce – Antennas are like cars. In our younger years, many of us drove our car fast and perhaps raced with others. Some of us got serious and raced competitively. While the factory did a fair job of providing a good engine, to be a "top winner" you learned many modifications and/or tweaks. ***The top winners learned the secret sauce.***

Do I have the secret sauce? I will let you decide. I am in the top 1% of the top 1% world wide per the ARRL DXCC Challenge. I am at the end of my DXing career and thus willing to pass on some of my tricks. The 10 minute window at our meetings does not allow this to happen. Because of that, today is only a "gloss over".

Big engine vs Secret Sauce – Most people think of a big engine as a high power amplifier. You can do 10 times more with a good antenna at fraction of the cost. Additionally an amplifier only helps TX while good antenna helps both RX and TX.

Big engine antenna (*not the secret sauce*) – Size of antenna (boom), tower height, location. Many of these we can not change. That's why many clubs create a club station. Location – Most of us cannot move to a house on a mountain. Tower - If lucky enough to have one, the average home tower is 35-50 ft. The average Yagi boom is 14-18 foot.

Secret sauce – For a given boom size many options are available. See below.



1- Element spacing variations: Two reasons for spacing variations, secret sauce and band changes. A Yagi antenna that fails to change spacing for each band is a compromise. Band changes are only one of the reasons. For a given band tweaking the spacing can provide a world of change.
2- Element length variations: Hard to notice in the picture above but only the driven element is at resonate length. The directors are progressively smaller and the reflector is larger than the driven element.

Changes in spacing and length affect… (*A topic too large for today*).

- Gain
- F/B - Front to back ratio
- Band width
- Beam width
- Nulls – Both signal and noise nulls. Noise nulls are valuable.
- Feeding impedance
- Overall performance – And more.