Antenna Construction Basics

Conductors
- Wire: Copper, Copper-clad steel, Aluminum, Galvanized steel
- Tubing: Copper, Aluminum, Galvanized steel (EMT)
- Other conductors; Aluminum Foil, Rain Gutters

Insulators
- Ceramic, glass, plastic, rubber, fiberglass, epoxy, wood

Connections
- Tight, Solid, Mechanically Sound, No movement
  - Nut & Bolt, Crimp, Kearney, Twist, Solder (pros & cons)
  - Beware of Dissimilar Metal Corrosion, Strain Relief feedlines
- Waterproof: Water Permanently Ruins Coax
  - Electrical tape is not enough!
  - Andrew Professional Kit, Scotch 130C, "Butyl" or putty and tape

Support (**Safety: *Beware of Power Lines***)
- Structure: Tower, Pole, Tree, Building, A-Frame Pylon (2x2's), "Man-helper"
- Suspension: Slingshot, Bow & Arrow, Climb
  - Wire vs. Rope, Dacron vs. Nylon Rope, Tensioning
  - Pulleys: Correct Size; If screwing into a tree, leave room for growth

Dimensions
- All antenna dimensions are relative to wavelength
- Lower frequency = longer elements
- Larger diameter = broader tuning (lower "Q")

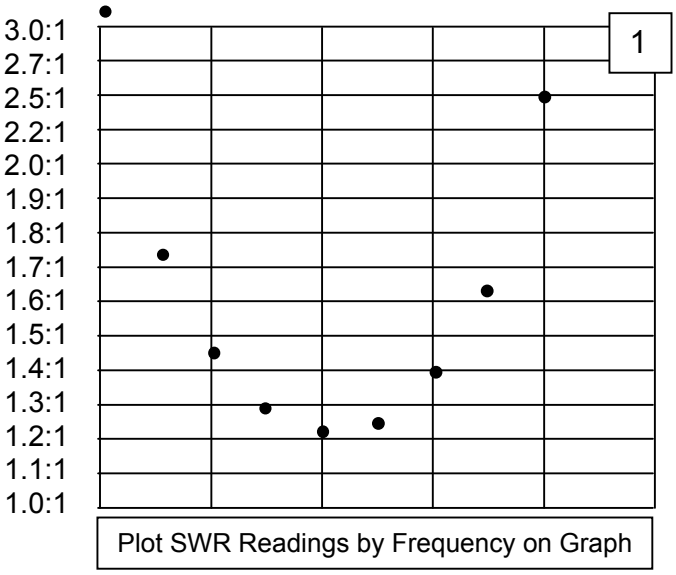
Horizontal antennas
- $468/F_{(MHz)} = L_{(feet)}$: Half-wave Dipole {for half-wave with no "ends" use $492/F_{(MHz)} = L_{(feet)}$}
- Coax feed; Balun, Lead feedline away perpendicular
- Multi-band strategies; Multiple dipoles on a single feed, Harmonics, Traps
  - Antenna Tuner may be applicable

Vertical antennas
- $234/F_{(MHz)} = L_{(feet)}$: Quarter-wave {for quarter-wave with no "ends" use $246/F_{(MHz)} = L_{(feet)}$}
- J-Pole; "End-fed Zepp", Vertically-oriented Half-wave Dipole with Matching Stub
- Ground System;
  - Resonant; 5% longer than Quarter-wave, at least three wires (Above Ground Surface)
  - Capacitive; at least 1/8-wave, several wires (On or Below Ground - see included chart)

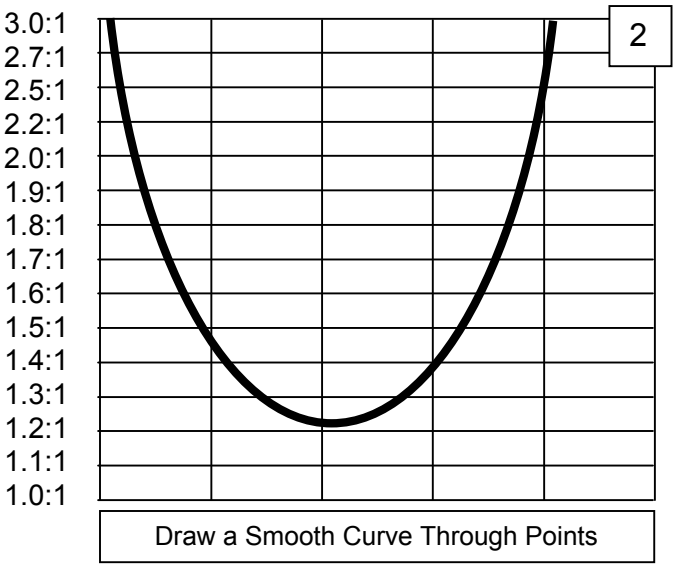
Tuning Basic Antennas
- SWR Meter; 1:1 is perfect; anything less than 2:1 is acceptable
- Write down and graph readings at several frequencies
  - Locate "Dip" in readings
- Trimming Antenna
  - Lengthen antenna to move "Dip" to Lower frequency
  - Shorten antenna to move "Dip" to Higher frequency

Antenna Tuner
- Should be located at the Antenna if possible; Everything beyond the Tuner is the Antenna
- Doesn't like tuning into Coax; Outside of Coax becomes part of the Antenna
- Open-wire feed; Requires Balun; May Require Good Ground
- End-fed wire; Some lengths won't work; Requires Good Ground
- May allow Multi-Band operation on a single antenna; All Tuners have Limits

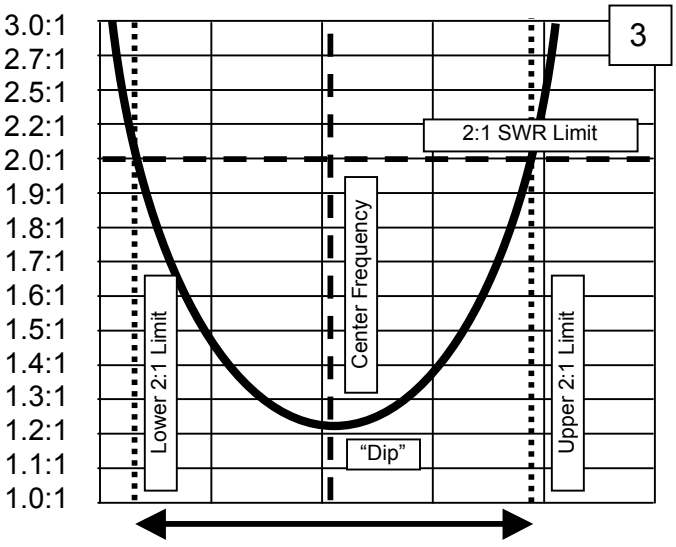
Tuning Antenna with SWR Meter



Plot SWR Readings by Frequency on Graph



Draw a Smooth Curve Through Points



Useable Antenna Bandwidth

Relative Metallic Conductance

Metal	(Ag)	(Cu)	(Res)
Silver	100%	108%	0.92
Copper	92%	100%	1.00
Gold	65%	70%	1.42
Aluminium	56%	61%	1.64
Calcium	47%	51%	1.95
Tungsten	28%	31%	3.26
Zinc	27%	29%	3.43
Nickel	23%	25%	4.06
Iron	16%	17%	5.81
Platinum	15%	16%	6.16
Tin	15%	16%	6.34
Lead	7%	8%	12.79
Mercury	2%	2%	56.98
Nichrome	1%	2%	63.95

Fwd Pwr	Ref Pwr	SWR
100	0.00	1:1
100	0.25	1.1:1
100	0.90	1.2:1
100	1.90	1.3:1
100	3.00	1.4:1
100	4.50	1.5:1
100	6.00	1.6:1
100	8.50	1.8:1
100	10.5	2:1
100	20.0	2.5:1
100	25.0	3:1

Length Formulas:

Half Wavelength "no end"
$492/F_{(MHz)} = L_{(feet)}$

Half Wavelength "with end"
$468/F_{(MHz)} = L_{(feet)}$

Quarter Wavelength "no end"
$246/F_{(MHz)} = L_{(feet)}$

Quarter Wavelength "with end"
$234/F_{(MHz)} = L_{(feet)}$

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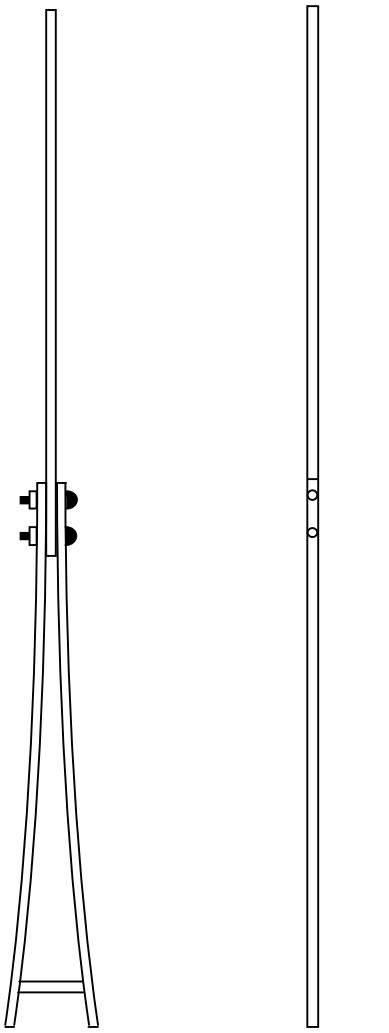
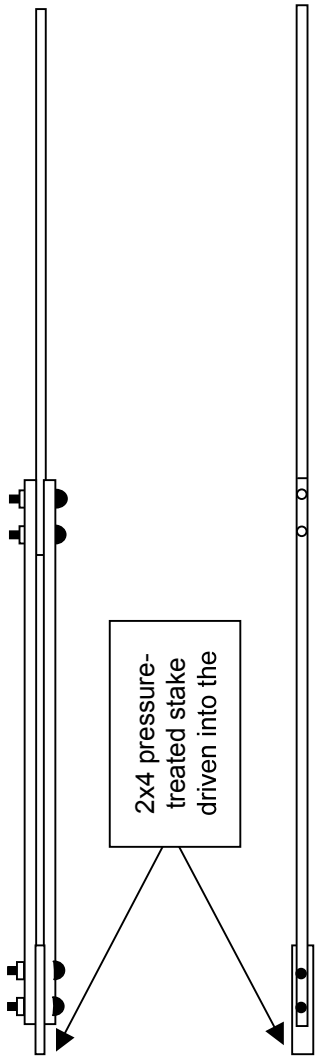
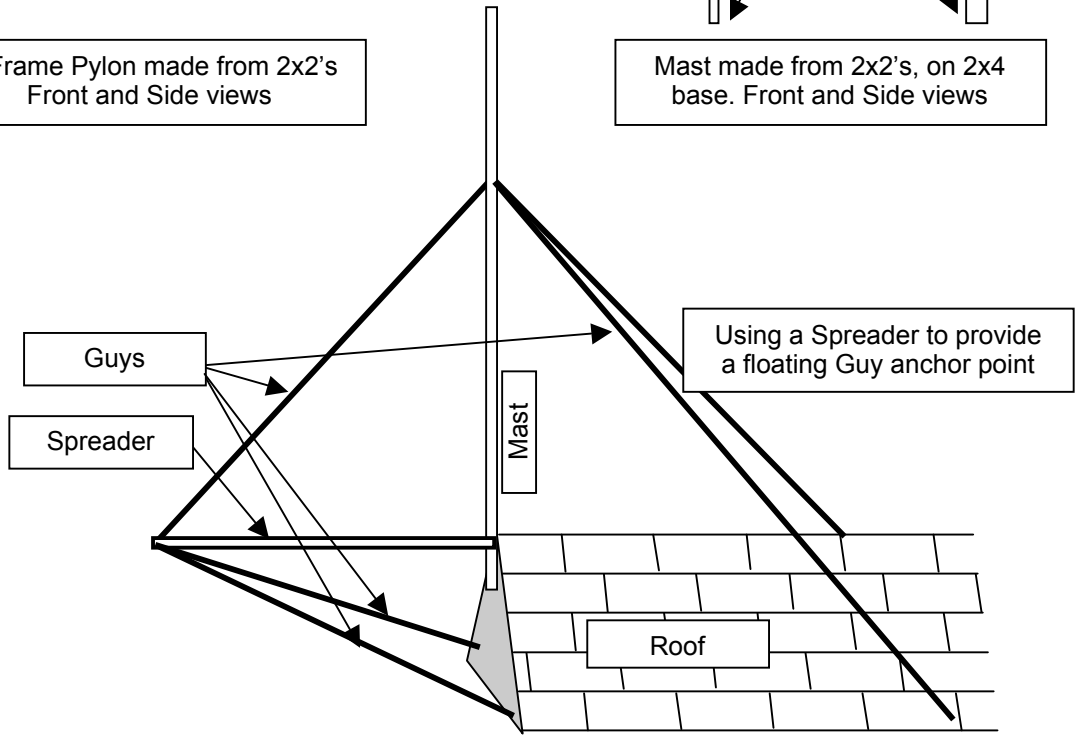


A-Frame Pylon made from 2x2's
Front and Side views



Mast made from 2x2's, on 2x4 base. Front and Side views



Radial Antenna Grounding System

Source: Hy-gain Antennas, div of MFJ Reference AV-18HT Manual Ground System for Vertical Antenna	A	B	C	D	E	F
Number of Radials	16	24	36	60	90	120
Length of each radial in wavelengths	.1	.125	.15	.2	.25	.4
Spacing of radials in degrees	22.5	15	10	6	4	3
TOTAL length of radial wire installed, in wavelengths	1.6	3	5.4	12	22.5	48
Power gain (dB) due to increased efficiency	3.0	3.6	4.0	4.7	5.2	6.0
Radiation take-off angle in degrees	30	30	30	30	28	24
Feed-point impedance in ohms with 1/4-wave radiating element	52	46	43	40	37	35
Radial end buried?	Yes	Yes	Yes	No	No	No