V.H.F. ANTENNAS - CONSTRUCTION AND USE

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INTRODUCTION

"A station is only as good as it's antenna". This is an unalterable truth which applies to any radio station irrespective of frequency of operation, kind of service or any other parameter.

The antenna launches electromagnetic energy into space from a transmitter or intercepts energy from a passing wave for further processing by a receiver. The antenna is the vital link between the station equipment and space which is the medium through which the signal is conveyed. Without a suitable and properly installed antenna, the best of equipment is of no use.

Antennas come in many shapes and sizes - from a simple dipole to very complex arrays - but all of them irrespective of shape, size and complexity follow the some basic principles. An understanding of the principles involved leads to a better understanding of the working of antennas.

There is no one antenna system which can be considered as best for all purposes but if one is armed with the necessary information, one should be able to - within the available resources - take the right steps to a successful antenna installation.

What then is the information required to choose an antenna intelligently, construct it properly so that it can weather the elements for a reasonable period of time before it requires an overhaul and install it successfully so that it gives you satisfactory performance? Without delving into the areas of antenna theory, wave propagation and transmission line mathematics, the following steps should enable you to reach the above goal. It should be noted however that since this discussion is restricted to VHF antennas the observations and statements are generally valid for the 2 meter band and above.

Step No.1

Determine what are the properties that you need in the antenna which you wish to install. We need to examine the following proerties.

a) **Polarization :** The aim of any 2 meter operator is see that his signals are received by other operators in his area and vice versa. Owing to the random location of stations it is essential to have an antenna with Omni-directional radiation properties. Besides, because of the widespread mobile use of 2 meter FM and the ease of mounting a vertically polarized antenna on a vehicle, the use of vertical polarization for 2 meter FM use has now become universal. Therefore the antenna under discussion would necessarily have to be vertically polarized.

b) **Gain :** The antenna should preferably have gain. There is no antenna magic by which the total energy radiated can be increased. However by narrowing the radiated pattern of the antenna to concentrate the radiated energy in a desired direction, the effective radiated power available at a desired point can be improved. This is how the gain of an antenna can be increased. In the case of the vhf band, normal propagation takes place by way of the ground wave and the space wave. Hence, our choice of antenna should be one that has maximum radiation at right angles to the vertical radiating element and none along it. We do not want our signals going vertically up into outer space - we want it to intercept the antennas dotted all around us.

c) **Bandwidth :** This is a measure of the ability of the antenna to perform without any deterioration of performance within a given band of frequencies.

d) **Impedance :** With the universal use of flexible co-axial transmission lines, the input impedance of the antenna should match the characteristic impedance of these lines viz 50 Ohms.

Now that we have defined the properties that we need in the antenna that we wish to install, let us now look at the different types of antennas that have some or all these properties.

Step No. II

Choosing the antenna :

The following are some of the vertically polarized antennas that one can buy or build.

1. **The 1/4 wave ground plane :** This is the simplest of all the antennas and consists of a vertical radiating element which is a 1/4 wave length long at the operating frequency. There are a minimum of 3 radials which are 5% longer than the radiating element and positioned at equal distances around the radiating element. The radials are normally bent at 45^0 degrees below the horizontal to ensure a better match for 50 ohms cable. The gain of the antenna is unity.

2. **The 5/8 lambda vertical :** This is a very popular antenna and widely used. The radiating element is 5/8 of wavelength long at the operating frequency. The radials are 5% longer than a quarter wavelength. An impedance matching network is required to match

the radiating element to 50 ohms co-ax cable. This antenna has an approximate gain of 3 db over a dipole and a reasonably low angle of radiation. It is possible to stack more than one 5/8 element in a collinear array with a proportional increase in gain. We shall discuss the construction of a single 5/8 lambda antenna in detail.

3. **The J Pole :** This is another very popular antenna which has the added advantage of not requiring a ground plane for its proper operation.

   This antenna however has the disadvantage of having a rather high angle of radiation. A variation of the J pole is the Slim Jim antenna which has a lower angle of radiation and hence a better radiation pattern.

4. **Vertically stacked dipoles :** The antenna consists of 4 dipoles stacked one on top of the other and separated from each other by a wavelength at the frequency or operation. This antenna exhibits an omnidirectional pattern if the dipoles are positioned at 90^0 to each other on the mast and has a gain of 6 db in this configuration. It exhibits a cardioid pattern when stacked one on top of the other and a gain of 9 db when assembled in this manner. This antenna is very popular for repeater installations.

5. **Collinear arrays:** This antenna consists of 2 or more half wave lengths operated in phase. When mounted vertically, this antenna has an omnidirectional pattern. It is not very popular as it becomes very unwieldy when more than 2 elements are used and because of difficulties in mounting the antenna vertically.

   The choice of a particular antenna from among the above would depend upon the individuals ability to build any one of them or the availability of commercially manufactured antennas.

   As far as simplicity, good performance, ease of building and low cost is concerned a 5/8 lambda antenna would be the best choice for both base station and mobile use.

STEP 3.

Transferring power form the transmitter to the antenna. With the universal use of commercially made equipment, the most convenient way of transferring power from the transmitter to the antenna is by using co-axial cable. The output impedance of all rigs being 50 ohms, the co-ax type to be used is either the RG 58, RG8 or RG213. All these types use solid polyethylene insulation between the centre conductor and the shield. Unfortunately the lower loss types using foam or air-spaced insulation are not yet manufactured in this country.

The loss figures per 100 feet at 144 MHz for the types mentioned above are as follows.

RG58 6db/100 feet
RG8/RG213 3db/100 feet

These figures would increase with age and also if the inner insulating material is exposed to moisture or chemicals. From the foregoing statements it is important to see that :—

a) The co-ax run from the transmitter to the antenna should be kept to the minimum possible to restrict the line losses.

b) Lower loss cables like RG8/RG213 to be used especially on the 2 meter band.

c) Connectors especially at the antenna or exposed end to be fitted correctly and precautions taken to water proof the joint to prevent entry of moisture into the cable.

The procedure to be adopted to fit various types of connectors to different types of cables is illustrated in every Amateur Radio Handbook and it would be worth every body's while to follow these instructions strictly for proper connection.

STEP No.4:

Installation: Now that we have chosen the antenna we wish to install and have either built or bought one, have acquired the right type of co-axial cable and have connected the right type of connectors at the ends, we are ready to install our antenna and fire the rig.

The higher the better within safety limits is the rule to be followed when installing an antenna. The best and the most convenient antenna mast is a full 20 feet length of C.I. water pipe which is readily available at all plumbers. A 3/4" or 1" diameter pipe of the smallest wall thickness viz A class should do the job admirably. Try and locate the antenna mast at the point where your cable would have the shortest run into the shack. Wherever possible use G.I. hardware for fixing your mast as they do not corrode like unprotected hardware and there is no danger of your installation coming crashing down at a later date. Provide strain relief for your cable by taping the co-ax down on to the mast so that the weight of the cable does not tug at the connector at the antenna end. Now that your antenna installation is over, connect up your cable to the rig and fire away! Happy hamming.