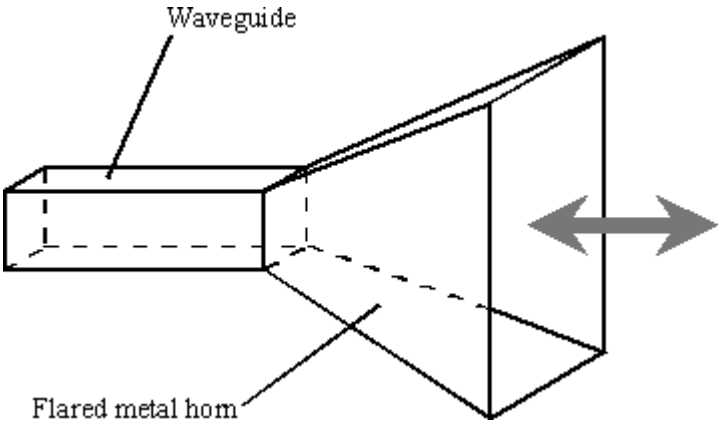
HORN AND HELICAL ANTENNA

Horn antenna:

A horn antenna is used for the transmission and reception of microwave signals. It derives its name from the characteristic flared appearance. The flared portion can be square, rectangular, or conical. The maximum radiation and response corresponds with the axis of the horn. In this respect, the antenna resembles an acoustic horn. It is usually fed with a waveguide.



In order to function properly, a horn antenna must be a certain minimum size relative to the wavelength of the incoming or outgoing electromagnetic field. If the horn is too small or the wavelength is too large (the frequency is too low), the antenna will not work efficiently.

Horn antennas are commonly used as the active element in a dish antenna. The horn is pointed toward the center of the dish reflector. The use of a horn, rather than a dipole antenna or any other type of antenna, at the focal point of the dish minimizes loss of energy (leakage) around the edges of the dish reflector. It also minimizes the response of the antenna to unwanted signals not in the favored direction of the dish.

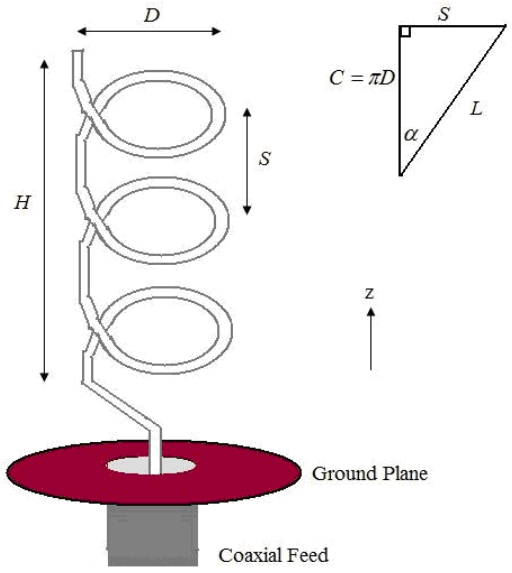
Horn antennas are used all by themselves in short-range radar systems, particularly those used by law-enforcement personnel to measure the speeds of approaching or retreating vehicles.

Helical antenna

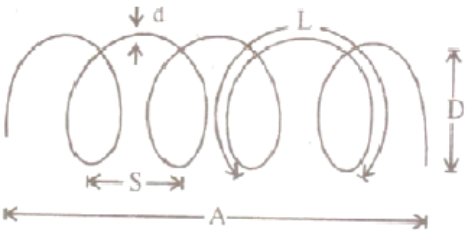
A helical antenna is a specialized antenna that emits and responds to electromagnetic fields with rotating (circular)polarization. These antennas are commonly used at earth-based stations in satellite communications systems. This type of antenna is designed for use with an unbalanced feed line such as coaxial cable. The center conductor of the cable is connected to the helical element, and the shield of the cable is connected to the reflector.

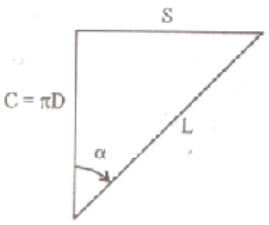
To the casual observer, a helical antenna appears as one or more "springs" or helixes mounted against a flat reflecting screen. The length of the helical element is one wavelength or greater. The reflector is a circular or square metal mesh or sheet whose cross dimension (diameter or edge) measures at least 3/4 wavelength. The helical element has a radius of 1/8 to 1/4 wavelength, and a pitch of 1/4 to 1/2 wavelength. The minimum dimensions depend on the lowest frequency at which the antenna is to be used. If the helix or reflector is too small (the frequency is too low), the efficiency is severely degraded. Maximum radiation and response occur along the axis of the helix.

The most popular helical antenna (often called a 'helix') is a travelling wave antenna in the shape of a corkscrew that produces radiation along the axis of the helix. These helixes are referred to as axial-mode helical antennas. The benefits of this antenna is it has a wide bandwidth, is easily constructed, has a real input impedance, and can produce circularly polarized fields. The basic geometry is shown in Figure



Geometry of Helical Antenna.





The helix parameters are related by

$$(\pi D)^2 = L^2 - S^2$$

Let S = Spacing between each turns
N= No. of Turns
D= Diameter of the helix
L'=A=Ns=Total length of the antenna
L= Length of the wire between each turn = $\sqrt{(\pi D)^2 + s^2}$
L_n= LN = Total length of the wire
C =πD= Circumference of the helix
α = Pitch angle formed by a line tangent to the helix wire and a plane perpendicular to the helix axis.

$$\alpha = \tan^{-1}\frac{s}{c} = \tan^{-1}\frac{s}{\pi D}$$

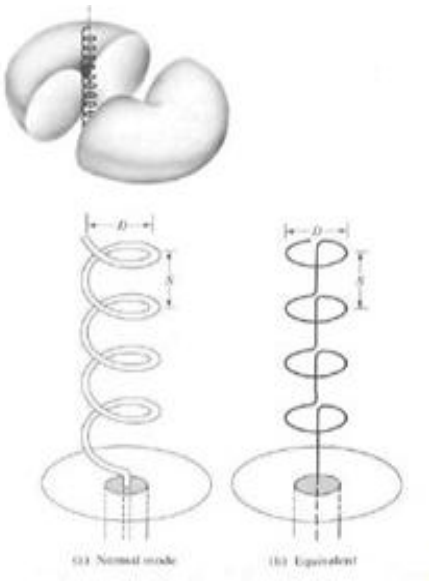
The radiation characteristics of the antenna can be varied by controlling the size of its geometrical properties compared to the wavelength.

Mode of Operation

- Normal Mode
- Axial Mode

Normal Mode:-

If the circumference, pitch and length of the helix are small compared to the wavelength, so that the current is approximately uniform in magnitude and phase in all parts of the helix, the normal mode of radiation is excited.



In normal mode as shown in fig 6.2 the radiation is maximum in the plane normal to the helix axis. The radiation may be elliptically or circularly polarized depending upon helix dimensions.

Disadvantages:

- Narrow Bandwidth
- Poor Efficiency

The radiation pattern in this mode is a combination of the equivalent radiation form a short dipole positioned along the axis of the helix and a small co-axial loop.

The radiation pattern of these two equivalent radiators is the same with the polarization at right angles and the phase angle at a given point in space is at 90^0 apart. Therefore the radiation is either elliptically polarized or circularly polarized depending upon the field strength ratio of the two components. This depends on the pitch angle α

When 'α' is very small, the loop type of radiation predominates, when it becomes very large, the helix becomes essentially a short dipole. In these two limiting cases the polarization is linear. For intermediate value of the polarization is elliptical and at a particular value of 'α' the polarization is circular