Horn Antennas

Flared waveguides that produce a nearly uniform phase front larger than the waveguide itself. Constructed in a variety of shapes such as sectoral E-plane, sectoral H-plane, pyramidal, conical, etc.

Horn Antennas -Application Areas

1. Used as a feed element for large radio astronomy, satellite tracking and communication dishes.
2. A common element of phased arrays.
3. Used in the calibration, other high-gain antennas.
4. Used for making electromagnetic interference measurements

Rectangular Horn antenna:

A rectangular horn antenna is as shown in figure 4.6. This is an extension of rectangular wave guide. TE_{10} mode is preferred for rectangular horns.

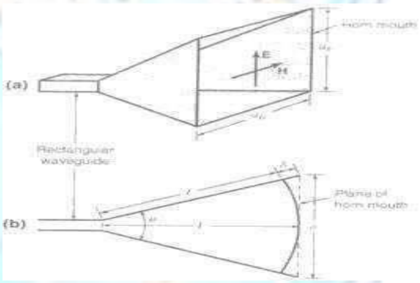

Fig 4.6: Rectangular Horn antenna

Horn antennas are very popular at UHF (300 MHz-3 GHz) and higher frequencies (Ihorn antennas operating as high as 140 GHz). Horn antennas often have a directional radiation pattern with a high antenna gain, which can range up to 25 dB in some cases, with 10-20 dB being typical. Horn antennas have a wide impedance bandwidth, implying that the input impedance is slowly varying over a wide frequency range (which also implies low values for S11 or VSWR). The bandwidth for practical horn antennas can be on the order of 20:1 (for instance, operating from 1 GHz-20 GHz), with a 10:1 bandwidth not being uncommon.

The gain of horn antennas often increases (and the beamwidth decreases) as the frequency of operation is increased. This is because the size of the horn aperture is always measured in wavelengths; at higher frequencies the horn antenna is "electrically larger"; this is because a higher frequency has a smaller wavelength. Since the horn antenna has a fixed physical size (say a square aperture of 20 cm across, for instance), the aperture is more wavelengths across at higher frequencies. And, a recurring theme in antenna theory is that larger antennas (in terms of wavelengths in size) have higher directivities.

Table:

Type of Aperture	Beam width, deg	
	Between First nulls	Between Half power points
Uniformly illuminated rectangular aperture or linear array	$\frac{115}{L_\lambda}$	$\frac{51}{L_\lambda}$
Uniformly illuminated circular aperture	$\frac{140}{D_\lambda}$	$\frac{58}{D_\lambda}$
Optimum E-plane rectangular horn	$\frac{115}{a_{E\lambda}}$	$\frac{56}{a_{E\lambda}}$
Optimum H-plane rectangular horn	$\frac{172}{a_{H\lambda}}$	$\frac{67}{a_{H\lambda}}$

Horn antennas are typically fed by a section of a waveguide, as shown in Figure 4. The waveguide itself is often fed with a short dipole, which is shown in red in Figure 4. A waveguide is simply a hollow, metal cavity (see the waveguide tutorial). Waveguides are used to guide electromagnetic energy from one place to another. The waveguide in Figure 4 is a rectangular waveguide of width *b*and height *a*, with *b*>*a*. The E-field distribution for the dominant mode is shown in the lower part of Figure 1.

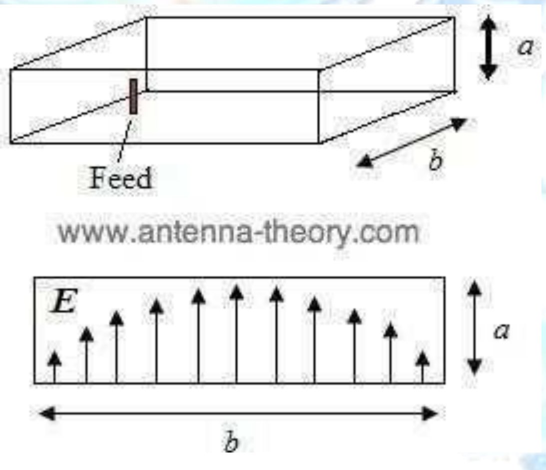

Figure 4. Waveguide used as a feed to horn antennas.