SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT302 - TRANSMISSION LINES AND ANTENNAS

III YEAR/ V SEMESTER

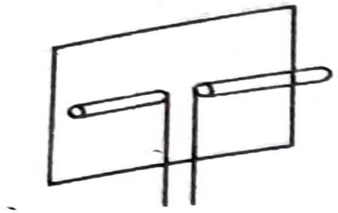
1

TOPIC– REFLECTOR ANTENNAS

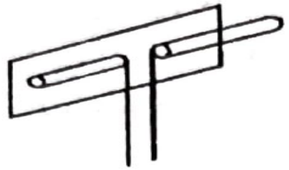
Reflector antenna

- An antenna reflector is a device that reflects electromagnetic waves.
- Antenna reflectors can exist as a standalone device for redirecting radio frequency (RF) energy, or can be integrated as part of an antenna assembly.
- The function of a standalone reflector is to redirect electro-magnetic (EM) energy, generally in the radio wavelength range of the electromagnetic spectrum.
- reflector antennas are widely used to modify the radiation pattern of the radiating element (antenna), increasing gain in a given direction.

Types of reflectors

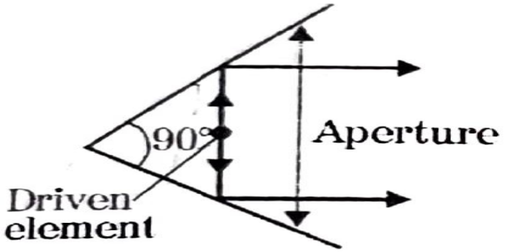


(a) Large flat sheet

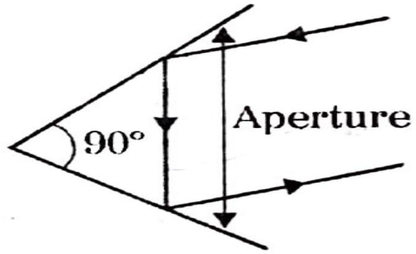


(b) Small flat sheet

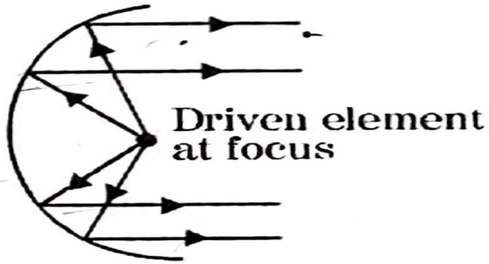
(c) Thin reflector



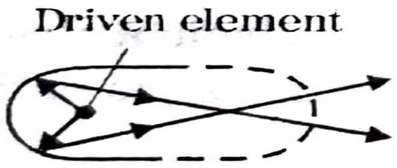
(d) Active corner reflector



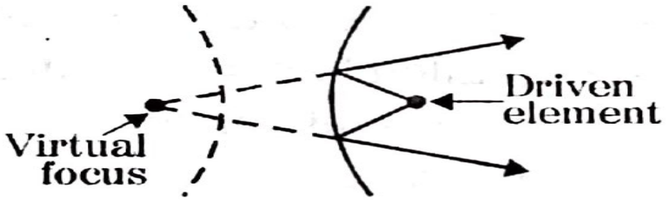
(e) Passive corner reflector



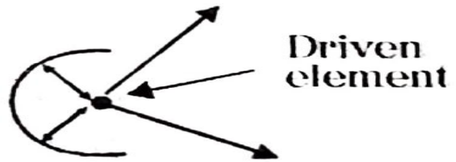
(f) Parabolic reflector



(g) Elliptical reflector



(h) Hyperbolic reflector



(i) Circular reflector

Types of reflectors

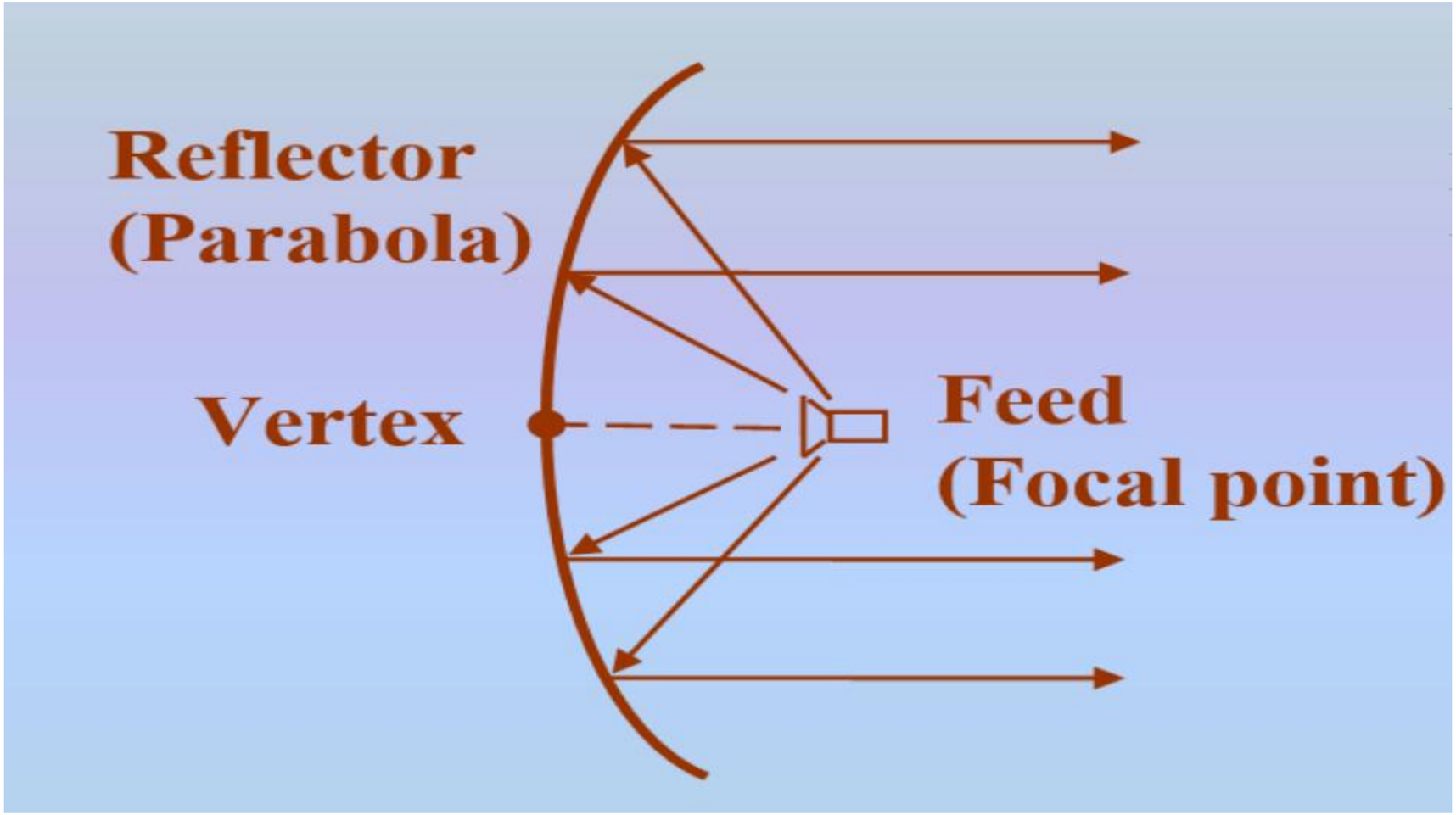
- Corner reflector, which reflects the incoming signal back to the direction from which it came, commonly used in radar.
- A corner reflector antenna is a type of directional antenna used at VHF and UHF frequencies. It consists of a dipole driven element mounted in front of two flat rectangular reflecting screens joined at an angle, usually 90°
- Flat reflector, which reflects the signal such as a mirror and is often used as a passive repeater.
- Flat reflector such as used in Sector antenna.
- A corner reflector used in UHF television antennas.
- Common integrated reflector types are parabolic reflector, which focuses a beam signal into one point or directs a radiating signal into a beam.

Parabolic Reflectors

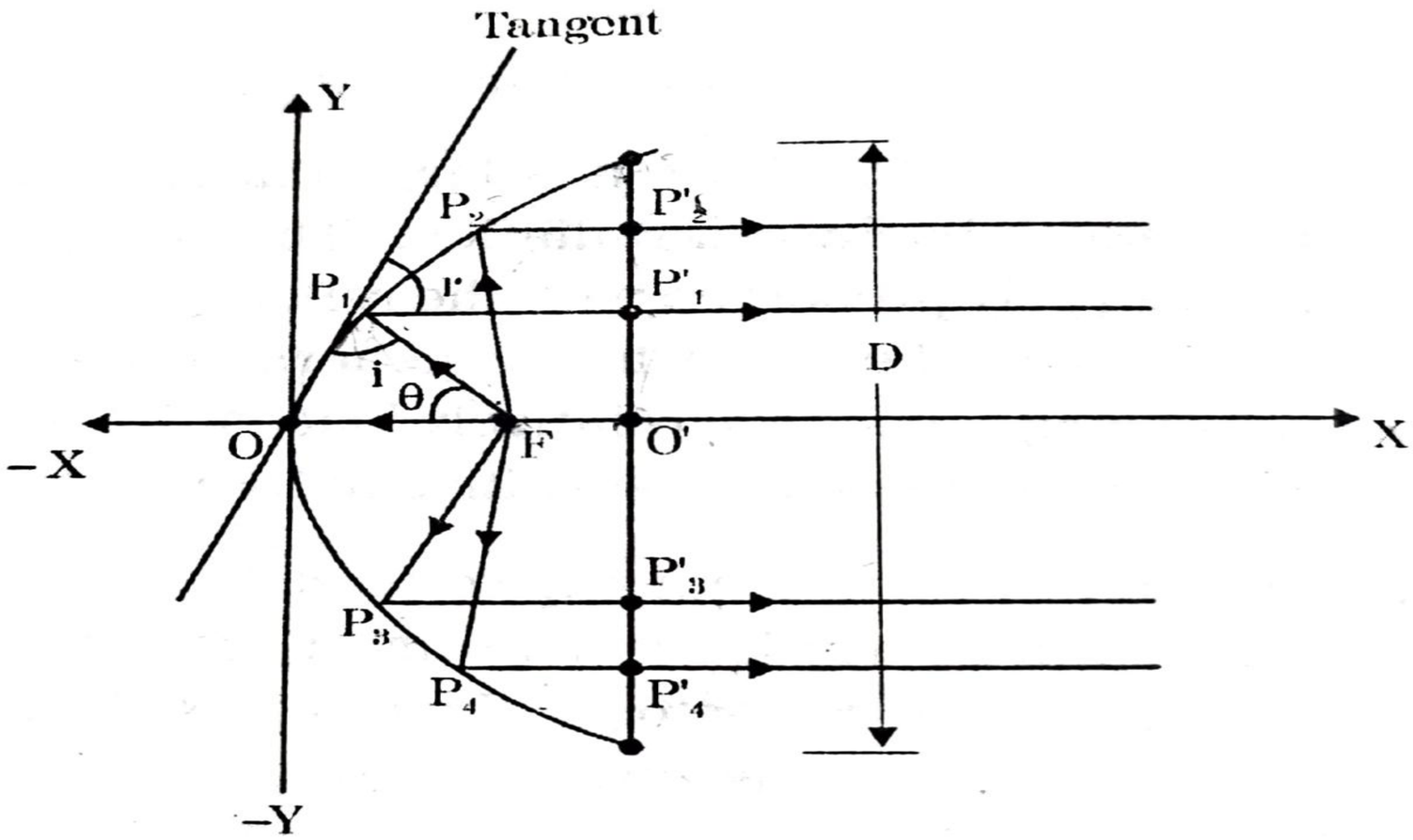
- Parabolic Reflectors are Microwave antennas.
- The most well-known reflector antenna is the parabolic reflector antenna, commonly known as a satellite dish antenna.
- These antennas are widely used for radio and wireless applications.
- Parabolic reflectors typically have a very high gain (30-40 dB is common).
- They also have a reasonable bandwidth, and can be very wideband in the case of huge dishes
- The smaller dish antennas typically operate between 2 and 28 GHz.
- The large dishes can operate in the VHF region (30-300 MHz), but typically need to be extremely large at this operating band.

Example of Parabolic Reflector Antenna

Parabolic Reflectors



Geometry of parabolic reflector



Geometry of parabolic reflector

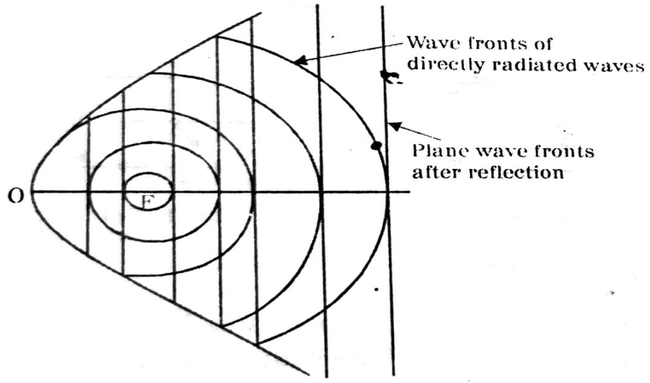
- The point F is the focus (feed is given) and V is the vertex. The line joining F and V is the axis of symmetry. PQ are the reflected rays where L represents the line directrix on which the reflected points lie (to say that they are being collinear).
- Hence, as per the above definition, the distance between F and L lie constant with respect to the waves being focussed.
- The reflected wave forms a collimated wave front, out of the parabolic shape.
- The ratio of focal length to aperture size (ie., f/D) known as “f over D ratio” is an important parameter of parabolic reflector.
- Its value varies from 0.25 to 0.50.

Geometry of parabolic reflector

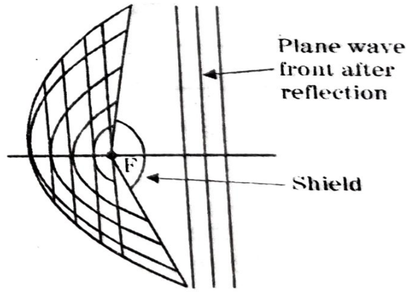
- The law of reflection states that the angle of incidence and the angle of reflection are equal. This law when used along with a parabola, helps the beam focus.
- The shape of the parabola when used for the purpose of reflection of waves, exhibits some properties of the parabola, which are helpful for building an antenna, using the waves reflected.
- All the waves originating from focus, reflects back to the parabolic axis. Hence, all the waves reaching the aperture are in phase.
- As the waves are in phase, the beam of radiation along the parabolic axis will be strong and concentrated.
- Following these points, the parabolic reflectors help in producing high directivity with narrower beam width.

Construction & Working of a Parabolic Reflector

- If a Parabolic Reflector antenna is used for transmitting a signal, the signal from the feed, comes out of a dipole or a horn antenna, to focus the wave on to the parabola.
- It means that, the waves come out of the focal point and strike the Paraboloidal reflector.
- This wave now gets reflected as collimated wave front, as discussed previously, to get transmitted.



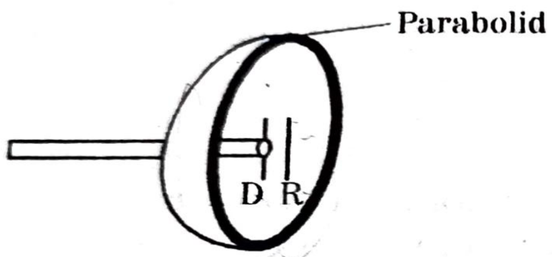
(a) Production of plane wavefront by parabolic reflector



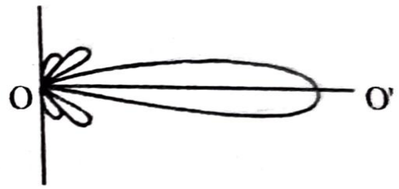
(b) With partially shield source

Parabolic reflector or microwave dish

- Parabola is a two-dimensional plane curve.
- Parabolic reflector or paraboloid is a three dimensional curved surface. It produces a parallel beam of circular cross section because the aperture of paraboloid is circular.
- Radiation pattern has a very sharp major lobe & minor lobes which are smaller in size.



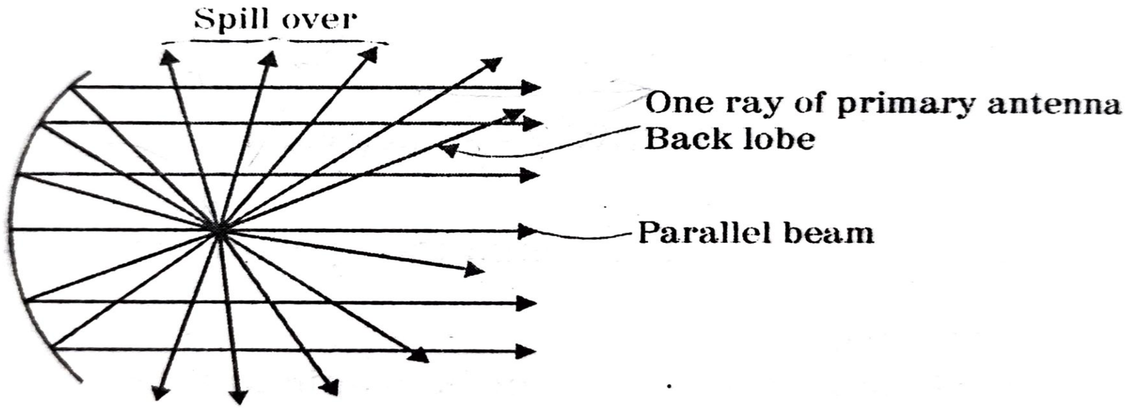
(a) Paraboloidal reflector with dipole at the focus



(b) Radiation pattern of a paraboloid

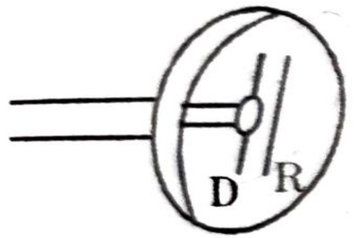
Spill over and backlobe

- Some desired rays are not captured by the reflector and these constitute spill over.
- In receivers, spill over increases noise pickup which is troublesome in satellite ground stations.
- Some radiations from the primary reflector occur in the forward radiation. This is known as the backlobe radiation – not desirable as it can interfere destructively.

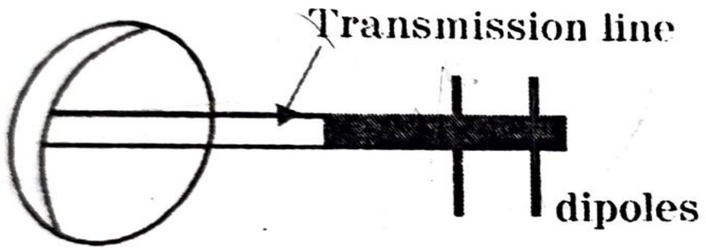


Feed systems of reflector antennas

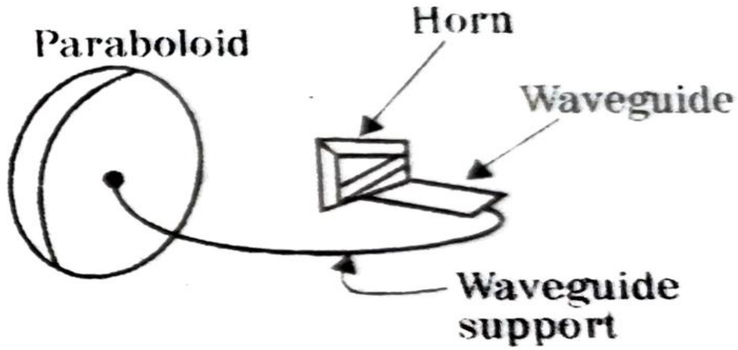
- Various feeds
  - ❖Dipole feed
  - ❖Horn antenna
  - ❖End fire antenna
  - ❖Cassegrain feed



(a) Dipole Feed



(b) Endfire Feed



(c) Horn Feed

Advantages & Disadvantages

Advantages:

- Reduction of minor lobes
- Wastage of power is reduced
- Equivalent focal length is achieved
- Feed can be placed in any location, according to our convenience
- Adjustment of beam (narrowing or widening) is done by adjusting the reflecting surfaces

Disadvantages:

- Some of the power that gets reflected from the parabolic reflector is obstructed. This becomes a problem with small dimension paraboloid.

Assessment

1. Which of the following wave conversion mechanism is performed in a parabolic reflector antenna?
   a) Plane to spherical
   b) Spherical to plane
   c) Performs both plane to spherical and spherical to plane
   d) Elliptic polarization
   Answer: b
2. Which of the following is a dual reflector antenna?
   a) Cassegrain antenna
   b) Parabolic antenna
   c) Offset reflector antenna
   d) Wire antenna
   Answer: a

THANK YOU