Horn Antennas

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Horn Antennas

- Invented in late 1800's. Studied in 1930's
- Most widely used microwave antenna
- Used as feed element
  - Radio astronomy
  - Satellite tracking
  - Communication dishes
- Universal standard for calibration and gain measurement of other antennas.

Types

- H-plane
- E-plane
- Pyramidal
- Conical

H-plane horn Antenna

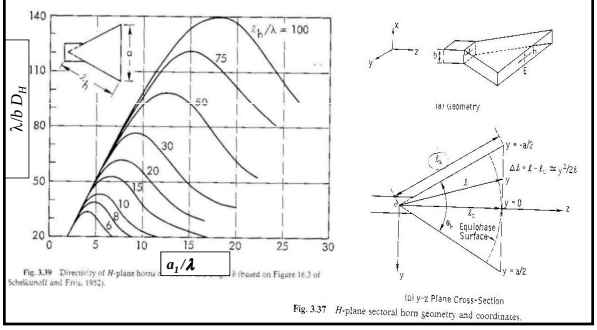


Fig. 3.39 Directivity of *H*-plane horns (based on Figure 16.3 of Schelkunoff and Friis, 1952).

Fig. 3.37 *H*-plane sectoral horn geometry and coordinates.

Directivity - H-plane horn

Fresnel Integrals S(x) & C(x)

- Can be computed from

$$D_H = \frac{4\pi U_{\max}}{P_{rad}} = \frac{4\pi b\rho_2}{a_1\lambda}\left\{[C(u)-C(v)]^2+[S(u)-S(v)]^2\right\}$$

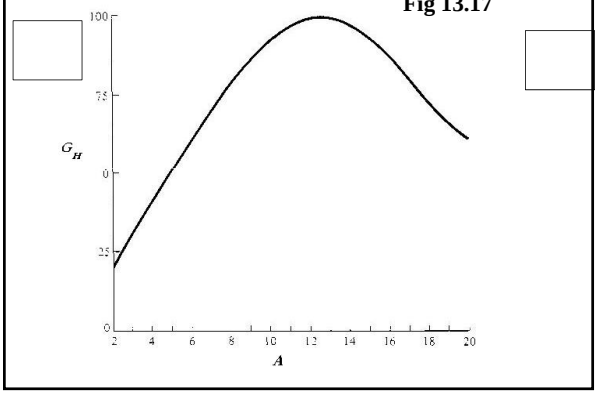
- Or from

$$A = \frac{a_1}{\lambda}\sqrt{\frac{50}{\rho_h/\lambda}} \qquad D_H = \frac{b}{\lambda}\frac{G_H}{\sqrt{\frac{50}{\rho_h/\lambda}}}$$

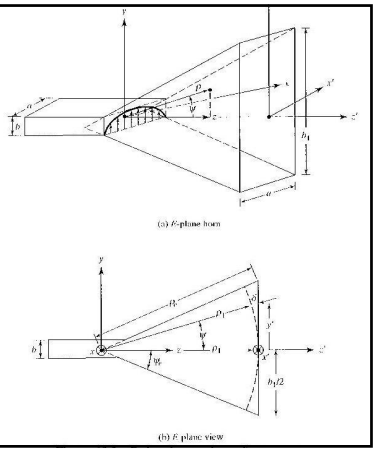
G_H and D are plotted on the fig.**13.16 &17** of Balanis.

- HPBW is found from fig. **13.15**.

Fig 13.17



E-plane horn



$$\tan 2\psi_e = \frac{b_1/2}{\rho_1}$$

Directivity - E-plane horn

Fresnel Integrals S(x) & C(x)

- Can be computed from

$$D_E = \frac{4\pi U_{\max}}{P_{rad}} = \frac{64 a \rho_1}{\pi b_1 \lambda}\left\{C^2\left(\frac{b_1}{\sqrt{2\lambda\rho_1}}\right) + S^2\left(\frac{b_1}{\sqrt{2\lambda\rho_1}}\right)\right\}$$

- Or from

$$B = \frac{b_1}{\lambda}\sqrt{\frac{50}{\rho_e/\lambda}} \qquad D_E = \frac{a}{\lambda}\frac{G_E}{\sqrt{\frac{50}{\rho_e/\lambda}}}$$

G_E from fig. 13.9 and D is plotted on the fig.**13.8** of Balanis.

- HPBW is found from fig. **13.7**.

E plane horn antenna

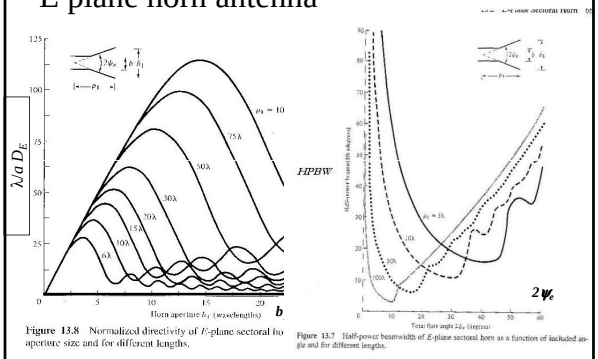
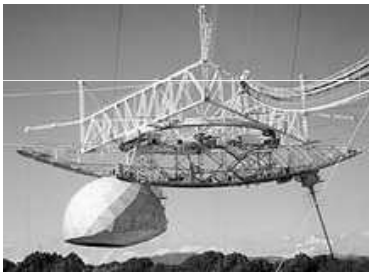


Figure 13.8 Normalized directivity of E-plane sectoral ho aperture size and for different lengths.

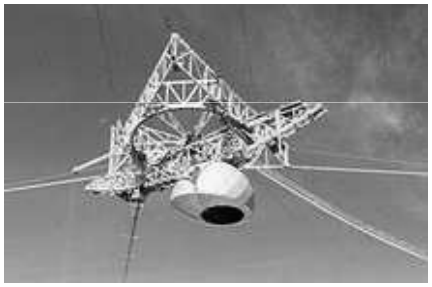
Figure 13.7 Half-power beamwidth of E-plane sectoral horn as a function of included an gle and for different lengths.

Gregorian feed

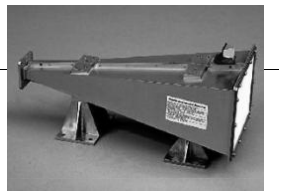


Arecibo Spherical Reflector

Feed



Pyramidal Horn



$$D_p = \frac{1}{32/\pi} \frac{G_E G_H}{\sqrt{\frac{50}{\rho_h/\lambda}} \sqrt{\frac{50}{\rho_e/\lambda}}}$$

$$D_p = \frac{\pi\lambda^2}{32ab} D_E D_H$$

Optimum pyramidal horn design

$$l_e = l_h \qquad l_h - l_o = \frac{3\lambda}{8} \qquad l_e - l_o = \frac{\lambda}{4}$$

$$D_p = \frac{\pi\lambda^2}{32ab} D_E D_H = \frac{\pi}{32} \left(\frac{D_{0e}}{a/\lambda} \right) \left(\frac{D_{0h}}{b/\lambda} \right)$$