DTG3F3
Teknik Antena
dan propagasi

Antena Horn

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Reference

Materi di ambil dari berbagai sumber :

"ANTENNAS
FROM THEORY TO PRACTICE"
Oleh Yi Huang dan Kevin Boyle

Dan

"ANTENNA THEORY
ANALYSIS AND DESIGN"
oleh Constantine A. Balanis

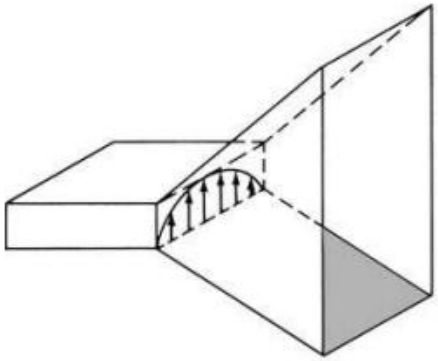
Dan

"ANTENNA THEORY AND DESIGN"
Oleh Warren L. Stutzman

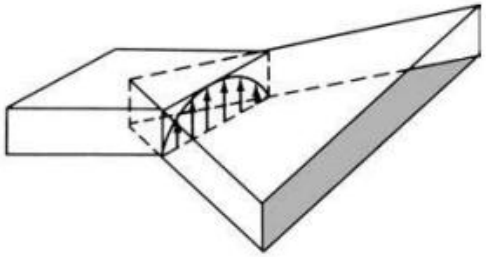
Antena Horn

Tipe antena Horn

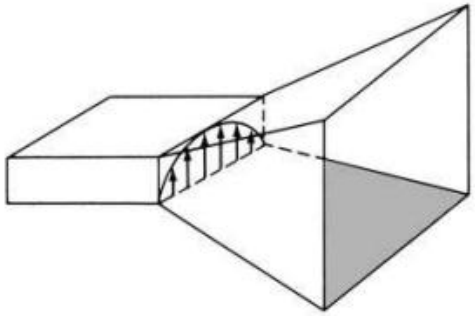
- E-PLANE SECTORAL HORN
- H-PLANE SECTORAL HORN
- PYRAMIDAL HORN
- CONICAL HORN



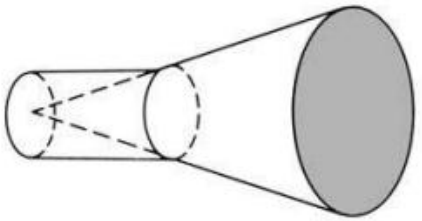
(a) *E*-plane



(b) *H*-plane

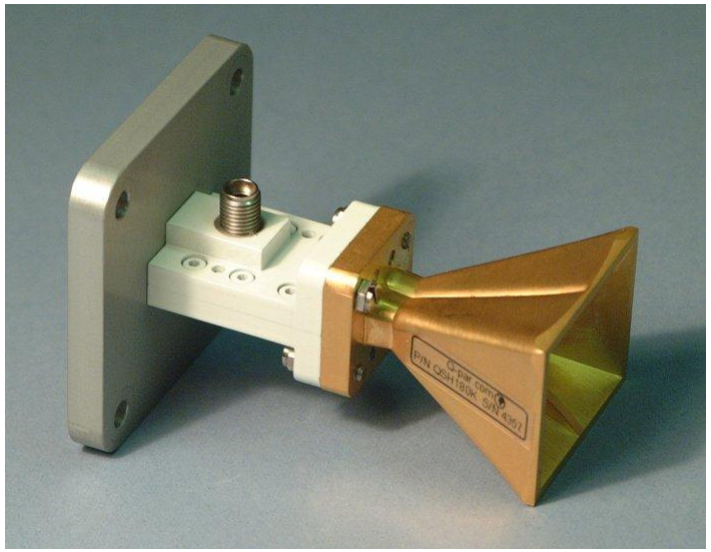


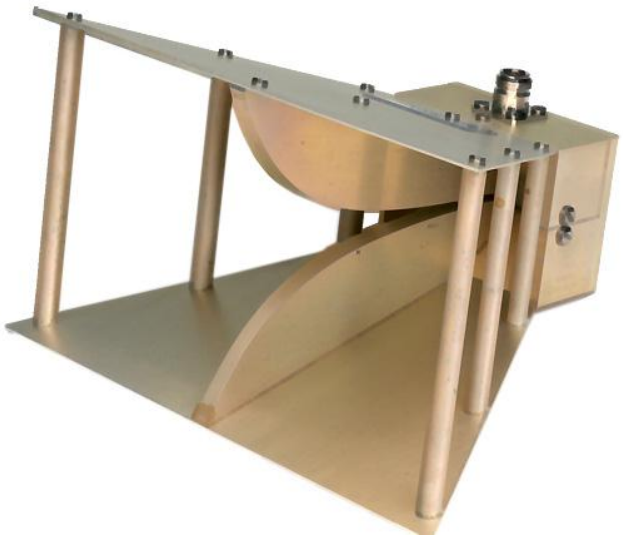
(c) Pyramidal



(d) Conical

Antena Horn





Antena Horn

Struktur dan karakteristik antena horn

- The horn is nothing more than a hollow pipe of different cross sections, which has been tapered (flared) to a larger opening. The type, direction, and amount of taper (flare) can have a profound effect on the overall performance of the element as a radiator
- The open-ended waveguide has a small directivity and broad beamwidth, Thus, it is not suitable for most practical applications. The pyramidal horn has therefore evolved from the open waveguide and it is flared in both the E- and H-planes, which results in high directivity and narrow beamwidths in both principal planes.
- the operation of a horn antenna can be viewed as analogous to a megaphone, which is an acoustic horn radiator providing directivity for sound waves. The electromagnetic horn acts as a smooth transition from the waveguide mode to the free-space mode.
- Karakteristik :
  - Jika panjang horn dibuat tetap dan sudut moncong horn membesar maka directivitas akan meningkat sampai pada batas tertentu (desain optimum) dan kemudian jika diperbesar melebihi desain optimum, direktivitasnya akan turun
  - Jika sudut moncong dibuat tetap dan panjang horn membesar maka direktivitasnya akan meningkat sampai pada batas tertentu (desain optimum) dan kemudian jika diperbesar melebihi desain optimum, direktivitasnya akan turun

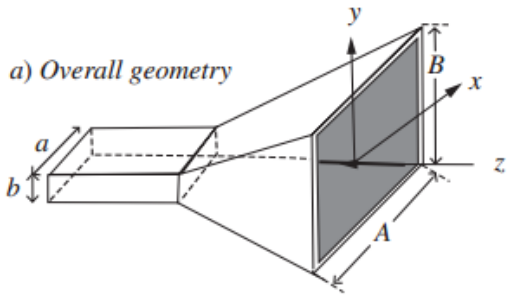
Antena Horn

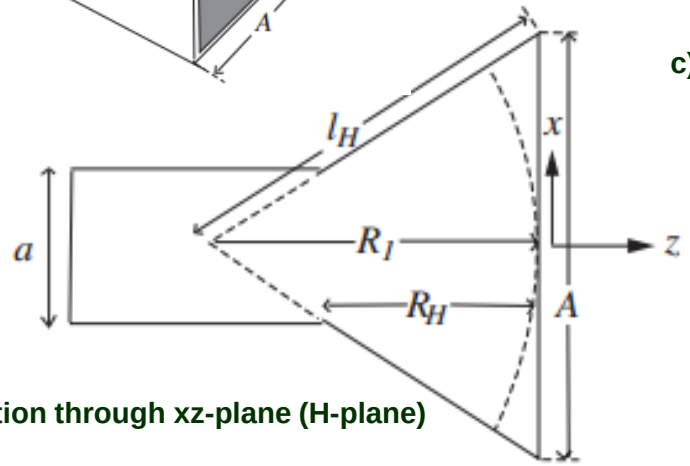
Aplikasi

- Horn antennas are mainly used for standard antenna gain and field measurements.
- Used for feed elements for reflector antennas and microwave communications.
- The horn is widely used as a feed element for large radio astronomy, satellite tracking, and communication dishes found installed throughout the world

Antena Horn

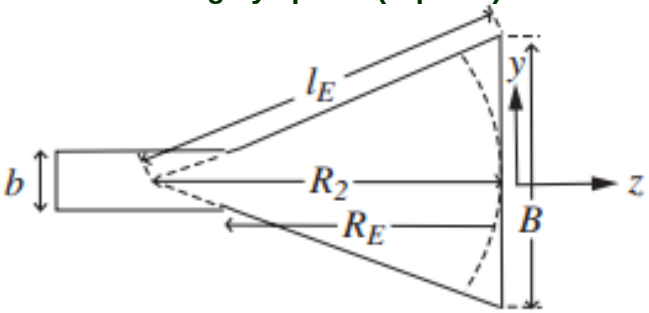
Design Procedure (piramidal Horn)





b) Cross-section through xz-plane (H-plane)

c) Cross-section through yz-plane (E-plane)



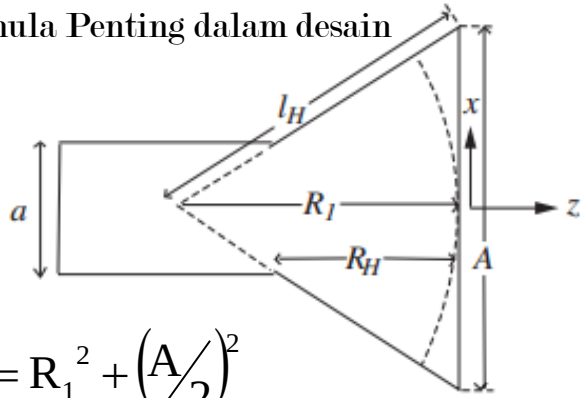
Ideally, the phase of the field across the horn mouth should be constant in order to obtain the desired pattern with minimized side lobes. This requires a very long horn. However, the horn should be as short as possible for practical convenience. An optimum design is therefore a compromise in which the difference in **the path length along the edge, l_E, and the center of the horn, R2, is made about 0.25λ**

Antena Horn

Design Procedure (piramidal Horn)

- Tujuan Desain :
  - Mencari Dimensi di E-plane (A, l_H, R_1, R_H)
  - Mencari Dimensi di H-Plane (B, l_E, R_2, R_E)
- Formula Penting dalam desain

1



$$l_H^2 = R_1^2 + \left(A/2\right)^2$$

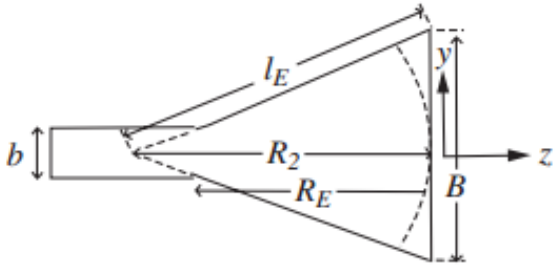
$$R_H = (A-a)\sqrt{\left(l_H/A\right)^2 - 0{,}25}$$

Maksimum perbedaan fasa

$$l_H - R_1 \approx \frac{1}{2R_1}\left(\frac{A}{2}\right)^2 = t\lambda$$

Deviasi fasa pada H-plane

Desain optimum →t = 3/8→ $A = \sqrt{3\lambda R_1}$



$$l_E^2 = R_2^2 + \left(B/2\right)^2$$

$$R_E = (B-b)\sqrt{\left(l_E/B\right)^2 - 0{,}25}$$

Maksimum perbedaan fasa

$$l_E - R_2 \approx \frac{1}{2R_2}\left(\frac{B}{2}\right)^2 = s\lambda$$

Deviasi fasa pada E-plane

Desain optimum →t = 1/4→ $B = \sqrt{2\lambda R_2}$

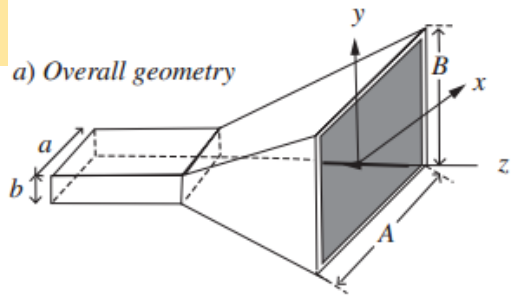
Saat digabung , harus :

$R_E = R_H$

Antena Horn

Design Procedure (piramidal Horn)

2



$$D_X = \frac{4\pi}{\lambda^2} A e m_X$$

$$= \frac{4\pi}{\lambda^2} \gamma A_p \Rightarrow$$

$$D = \frac{4\pi}{\lambda^2}(\gamma AB)$$

Saat Desain optimum → $\gamma = 51\%$

Persamaan pada formula-formula pada poin **1** bukanlah persamaan linear → sulit mencari solusinya

Dengan manipulasi matematika :

$$(B-b)\frac{B}{s} = (A-a)\frac{A}{t}$$

$$B = \frac{b + \sqrt{b^2 + 4sA(A-a)/t}}{2}$$

Disubsitusikan

$$A^4 - aA^3 + \frac{tbD\lambda^2}{4\pi s\gamma} A = \frac{tD^2\lambda^4}{16s\pi^2\gamma^2}$$

Bisa diselesaikan dengan trying error atau numerical method

Sebagai acuan :

$$A = 0{,}45\lambda\sqrt{D}$$

$$HPBW_H = 78^\circ \frac{\lambda}{A}$$

$$HPBW_E = 54^\circ \frac{\lambda}{B}$$

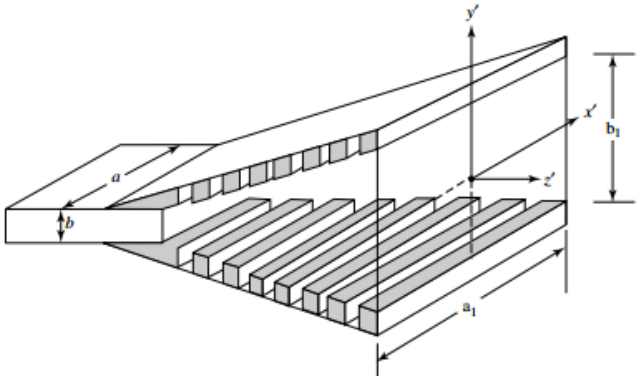
Antena Horn

Contoh Soal

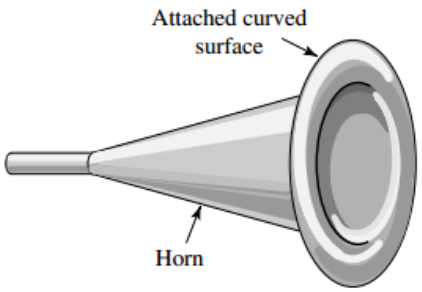
Rancang suatu antena piramidal horn dengan D = 20dBi, pada frekuensi 10 Ghz. dengan dimensi waveguide pencatu a = 22,86 mm dan b = 10,16 mm

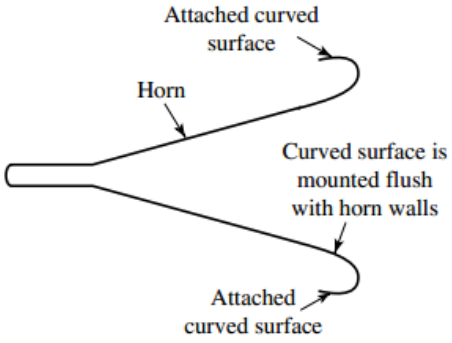
Antena Horn

Modifikasi Antena Horn



Corrugated horn





Aperture-matched Horns

Double Ridge Horns

Questions???

Telkom University

Thank You !