①

factors influencing the selection of antennas

- efficiency
- Directive gain
- antenna imp
- structural constraints

LF → h ↑.

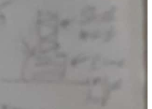
only vertical antenna with vertical polarization

$\lambda = \frac{3 \times 10^8}{300 \times 10^3} = 1km$

improve performance of LF antennas

electrical height ↑ → high base imp → ↓ base input current ⇒ Less ground losses

High masts



LF & VLF antennas

- some operating principles

LF & VLF together called < 300kHz

- Difficult to obtain appreciable directivity in horizontal plane

use - omni directional coverage

telegraph tx ion to ships, Radionavigation

- short monopole h = λ/8 horizontal plane

Pattern in vertical plane:

h ↑ pattern becomes flat

λ/10

λ/4

due to Less → Power → most → dissipated ; Small - radiated

Prad

$\eta = \frac{P_{rad}}{P_{rad} + P_{loss}}$

↓ losses in antenna c… + losses in matching c…

$P_{rad} < P_{loss}$ ∴ η ↓ drastically

means of improving % η of LF antennas

① → improve conductivity of ground ↓ ohmic loss

↓ conductor loss

→ by selecting a suitable conductor like phosphorous bronze, heavy guage wire,

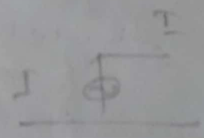
$R_r = 4\Omega$ $d = \lambda/10$

$l_a = 6\Omega$ $l = \lambda/4$

→ R_{rad} ↑ by increasing effective height (l_e)

– effective height (l_e) $= \frac{2}{\pi}$ (actual height)

– Capacitance hat ↑ effective height

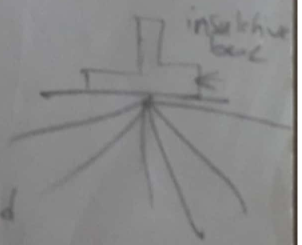


– current at top is no longer '0'

– if vertical and horizontal portion is of comparable length l_e increases from 0.5λ to 0.75λ.

– capacitance hat can also be achieved by guys

→ ① increasing conductivity of ground



↳ also called earth mat

– consists no of radial wires buried

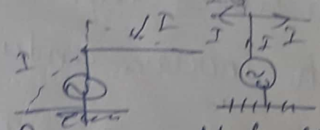
– angle of seperation = 3°

– 20 to 30 cm below ground

– 20 to 30 wires

- Effective height (l_e) = $\frac{2}{\pi}$ (actual height)

- the capacitance hat at the increases the (l_e) because current at the top is no longer zero due to horizontal capacitance hat

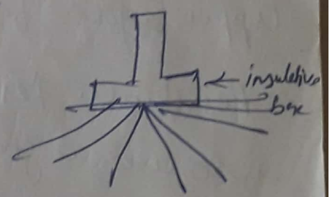


- hat is in the form of T or L
- if vertical and horizontal portion is of comparable length l_e increases from 0.5λ to 0.75λ.
- Cap hat can also be achieved by guys

ways of improving r.η. of antennas :-

1) increasing conductivity of ground
2) Reducing antenna conductor loss
3) increasing Rrad

Buried Radial wire ground system



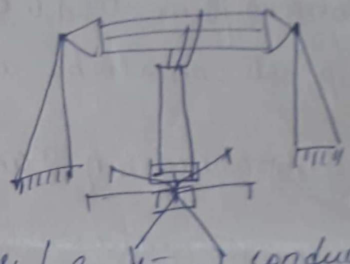
- Also called earth mat
- consists of no of radial wires buried below the antenna in the ground
- Angle of separation b/w wires = 3°
- buried 20 to 30 cm below ground, about 20 to 30 wires are used
- ideally each wire should have length of $\lambda/4$ to $\lambda/2$ practically length = $\frac{1}{2}$ height of antenna

All these wires are braced {ring meltchic ^ sh soldered)

All wires will be joined together at half length to increase conductivity

metallic strips are attached to ends to increase conductivity further in (deep soils)

counter poise earth: one the antennas top a building here we dont burry the wires but they are placed above the surface of the ground.



Reducing ground loss resistance / antenna conductor loss

✓As freq increases current will be limited to the upper layers of the conductors only this is called skin effect

Resistance ↑es with freq.

1) So use a good conductors like Bale stranded copper (or) phosphor Bronze wire

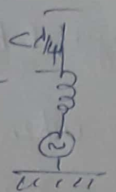
2)✓ use a heavier guage wire / as diameter ↑ cross section area of wire ↑es = resistance is less

–✓if we use small wire

→ As they are supposed to carry large powers

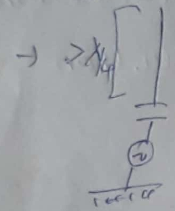
– voltage gradiant may increase more than required

✓Antenna is not resonant length for a given operating freq,
it should be atleast λ/4 to resonate.
- its i/p imp contains some reactive component
- As grounded antenna <λ/4 → i/p imp cap reactance



to attain Resonant length

→ >λ/4

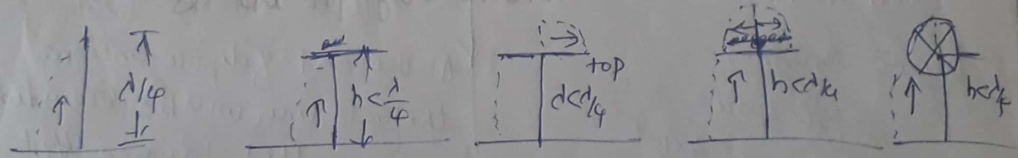


>λ/4 → i/p imp is inductive

So that imp is resistive

✓However radiation η is sacrificed by use of series inductance & and capacitance add to loss resistance and there is no improvement in radiation resistance. η can be improved by increasing

✓Top loading is answer



✓current of the base ↑ in antenna, current distribution becomes more uniform

✓current in horizontal is smaller than vertical portion
antenna works as vertically polarized antenna

✓ the resultant current distribution along the vertical portion is similar to that as if extra vertical section is added current along the upper portion of vertical antenna increases so also R_{rad} and η

physical height & effective height of an antenna :-

✓ when a conductor of finite diameter is used as a radiator it usually behaves electrically as if it was taller than physical height

✓ Effective height $= \frac{2}{\pi}$ physical height

Reason:-

✓ wave velocity in conductor is less than its velocity in free space

- Effect of top loading, - end effects, - non uniform of antenna cross section.

Dipole antennas :-

In free space

$$\lambda = \frac{c}{f} = \frac{3\times10^8}{f \text{ in MHz}}$$

$$= \frac{300}{f \text{ in MHz}}$$

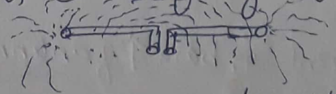
$$\lambda/2 = \frac{150}{f \text{ in (MHz)}} \text{ meters}$$

$$1m = 3.28 \text{ feet} \quad = \frac{150}{f \text{ in MHz}} \times 3.28 \text{ feet}$$

$$1m = 39.37 \text{ inch} \quad = \frac{150}{f \text{ in MHz}} \times 39.37 \text{ inch}$$

End effect or fringe effect :-

✓ At the end of dipole antenna the field lines will be crowded. this is called fringe effect



Reason: ✓ at the ends large storage of charge is seen at the end compared to other places

✓ Due to accumulation of charges

✓ To rectify we use slightly small antenna than required.

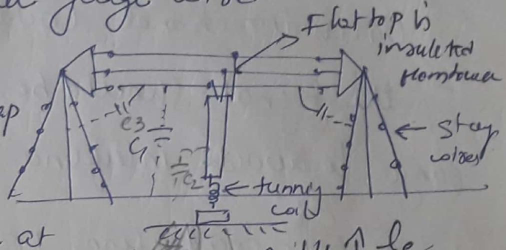
✓ about 5% to counter fringe effect

suddenly and causes breakdown of material.

- A faint bluish glow will be appearing which ionises air this wastes the power
- If applied voltage > 30kV/cm breakdown occurs

This is called corona (or) brush discharge we can avoid this by using higher guage wire

typical LF antenna:



- its value depends on various cap. Dimension is much smaller than $\lambda/4$

For an antenna < $\lambda/4$ impedance at terminals is —ш—||—

$C_1 \rightarrow$ large as possible ↑ le

$C_2 C_3 \rightarrow$ small as possible

non radiative cap

for antenna > $\lambda/4$ impedance at terminals is —ш—ᗰ—

C_4

generally a tuning coil is provided to match the impedance to cancel out extra impedance and make it purely resistive

$V_L = X_L I = X_c I$.

$V_L = \omega L I = \frac{1}{\omega C} I$.

$= \frac{1}{\omega C} I$

$= \left[\sqrt{\frac{L}{C}}\right] I$

Voltage across inductance

$\omega L I = \frac{1}{\omega C} I$

$\omega^2 = \frac{1}{L C_1}$.

$\omega = \sqrt{\frac{1}{L C_1}}$

$V_L = \omega L I$

$V_L = \frac{1}{\sqrt{L C_1}} L I$.

$= \sqrt{\frac{L}{C_1}} I$

- the larger the voltage capacitance at the terminals the smaller the voltage across tunning inductor antenna. [which in turn avoids corona discharge] larger the value of C_1 also reduces voltage across tuning inductance

(Voltage gradient is less)

medium fly antinnas - tower antinnas-

→ ✓ 0.3 to 3 MHz are called medium fly antinnas

→ National broadcasting purposes local broadcasting purpose

✓ easily have an antinne of som but difficult to achieve directivity in Horizontal plane

✓ omnidirectional coverage

- the signal should be completely attenuated after some range to avoid interference in broadcasting with other stations

✓ Antinne radiation propagation should be maximum radiation in horizontal plane minimum radiation in upward.

Ionosphere propagation: total internal reflection

(Surface wave a ionosphere - ground wave propagation) higher fly comes are more so beyond 3 MHz ground wave propagation is cut

D layer is present in day time only, there is interference b/w direct energy & reflected energy causing fading.

- if D layer is not present the energy goes upward gets reflected causes fading

During noon time - ionospheric densities are more

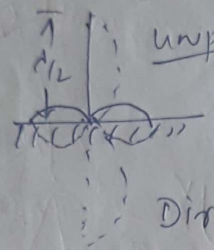
- range in height from d/6 to d/5 physical height ranges from 45 to 3cm..

MF antennas:

tower antennas

Audio freq range – 20 – 20kHz

Series Fed excitation



unipole the current at terminals of a λ/2 antenna are small so low ground losses

Directive gain of λ/2 unipole: 1.7 dB above of λ/2 dipole in free space

$= 1.7 + 2.15 = 3.85$ dB

two remove the side lobes we require 0.53λ. though high angle lobes are present. the angle lobes are 30dB down almost negligible.

1) Rrad of this depends on cross section of antenne

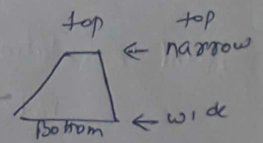
A typical value of Rrad = 400Ω (unipole

%η is more (80–90%)

~~Difficult to predict~~

Fabrication of tower antennas.

structural and electrical problems



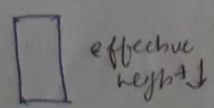
tappered tower decrease of current at the top of the antenne

as cross sectional area ↓ it offers more resistance

Radiated field as well as power ↓

Electrically a parallel mast is preferred

Sino Soidal current distribution

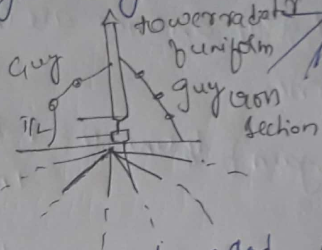


circular capacitance hat :

there are spokes present

this is placed on top of the antenna

saving 5-10% in height using circular cap hat



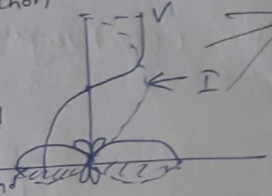
grounded towers :

For txion line :

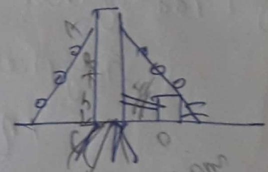
V - should be max at oc end

I - should be min at o.c end

I - max at centre



grounded towers : when antenna use to propagate high power designing dielectrics are very difficult in such case antennas are grounded - Shunt feed is used.



Shunt excitation :

- not insulated from ground

- It enables ~~to~~ to eliminate base insulator, tower lightning chokes and other lightning protective devices

Shunt fed will have minimum lobes.

ARE RE form
. loop
ore tors
induce

BC is handled by
capacitance