2.1 INTRODUCTION:

SKIN EFFECT:

Consider a conductor made up of a large number of fine strands of wire. A strand at the center is linked by all the internal flux in the conductor, whereas a stand on the surface is not linked by the internal flux. The inductance and reactance of the strand at the center is greater than that of the strand at the surface. The interior strand thus carries less current than the outer so as to produce equal impedance drops along the strands. This phenomenon is known as **skin effect**.

When a line, either open- wire or coaxial, is used at frequencies of a megacycle or more, certain approximations may be employed leading to simplified analysis of line performance.

THE ASSUMPTIONS USUALLY MADE ARE:

1) At very high frequency, **the skin effect is very considerable** so that currents may be assumed as flowing on flowing on conductor surfaces, internal inductance then being zero.
2) Due to skin effect, resistance R increases with $\sqrt{f}$. But the line reactance ωL increases directly with frequency f. Hence ωL >> R.
3) The lines are well enough constructed that G may be considered zero.

ANALYSIS IS MADE IN EITHER OF TWO WAYS:

1) R is merely small with respect to ωL. If **R is small**, the line is considered as one of **small dissipation**, and this concept is useful when the lines are employed as circuit elements or where resonance properties are involved,
2) R is completely negligible as compared to ωL, and the line is considered as one of zero dissipation and this concept is used for transmission of power at high frequency.

LINE CONSTSNTS OF DISSIPATION LESS LINE

In gerenal the line line constants for a transmission line are:

$$Z_o = \sqrt{\frac{Z}{Y}}$$

Z = R+jωL

Y = G+jωC

$$Z_o = \sqrt{\frac{R+j\omega L}{G+j\omega C}}$$

γ = α+jβ

$\gamma = \sqrt{ZY}$

$\gamma = \sqrt{(R + j\omega L)(G + j\omega C)}$

According to the standard assumption for the line at high frequency

$j\omega L >> R$, $j\omega C >> G$

R = 0 , G = 0

Sub the condition in Z_o , γ

$Z_o = \sqrt{\frac{j\omega L}{j\omega C}}$

$Z_o = \sqrt{\frac{L}{C}}$

$\gamma = \sqrt{(j\omega L)(j\omega C)}$

$\gamma = \sqrt{(j^2\omega^2 LC)}$

$\gamma = \sqrt{(-\omega^2 LC)}$

$\gamma = j\omega\sqrt{LC}$

$\alpha + j\beta = j\omega\sqrt{LC}$

equate the real and imag parts,

$\alpha = 0$

$\beta = \omega\sqrt{LC}$

$v = \frac{\omega}{\beta}$

$v = \frac{\omega}{\omega\sqrt{LC}}$

$\boldsymbol{v = \frac{1}{\sqrt{LC}}}$

$\lambda = \frac{2\pi}{\beta}$

$\lambda = \frac{2\pi}{\omega\sqrt{LC}}$

There are the line constants for dissipation less line.

2.2 PARAMETERS OF THE OPEN WIRE LINW AT RADIO FREQUENCY

a) LOOP INDUCTANCE:

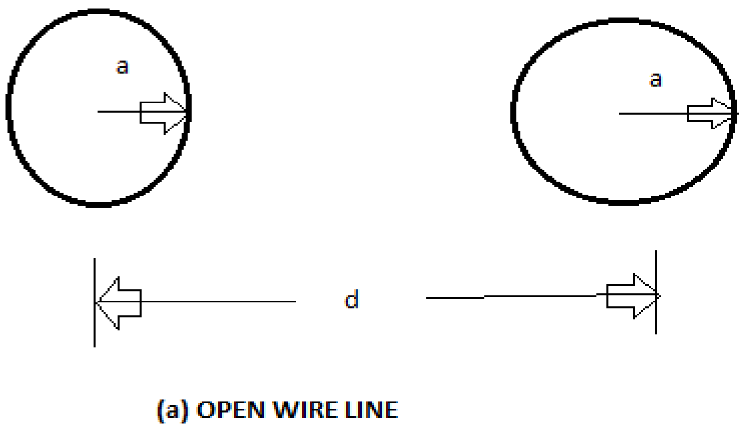

Fig : 2.2.1 Loop inductance of Open wire line

In Fig 2.2.1 shows that it consists of two spaced parallel wire supported by insulators; at proper distance to give a desired value of inductance.

a = Radius of the each line

d = Spacing between two parallel lines

Inductance of an open wire line is given by,

$L = \frac{\mu_0}{2\pi} \ln \frac{d}{a}$

$L = \frac{4\pi X 10^{-7}}{2\pi} \ln \frac{d}{a}$ H/m

The self-inductance of an open wire lines together is given by,

$L = 0.1\ \mu_r + 0.921\ log_{10} \frac{d}{a}$ H/m

Where,

a = radius of the conductor

d = distance b/w the conductor

μ_r = Relative permeability of the conductor

b) LOOP INDUCTANCE IN COAXIAL CABLE:

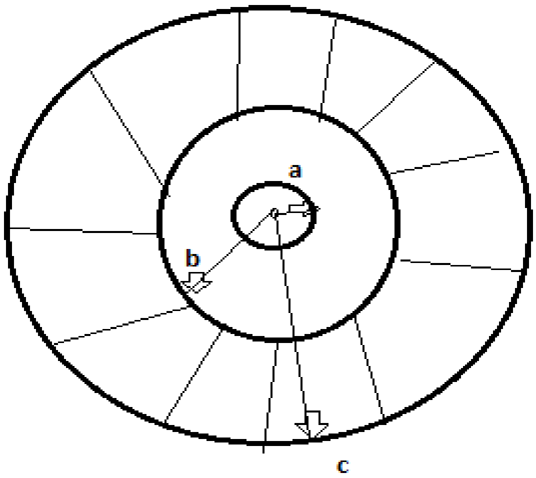

Fig : 2.2.2 Loop inductance of Coaxial cable

In Fig 2.2.2,

$$L = \frac{\mu_d}{2\pi} log_e \left(\frac{d}{a}\right) + \frac{\mu_c}{2\pi} \left[\frac{4c}{c^2 - b^2} \log \left(\frac{c}{b}\right) - \frac{2c^2}{c^2 - b^2}\right]$$

a = radius of the inner conductor

b = inner radius of the outer conductor

c = outer radius of the outer conductor

μ_c = permeability of the conductor

μ_d = permeability of the dielectric.

SHUNT CAPACITANCE:

a) FOR OPEN WIRE LINE:

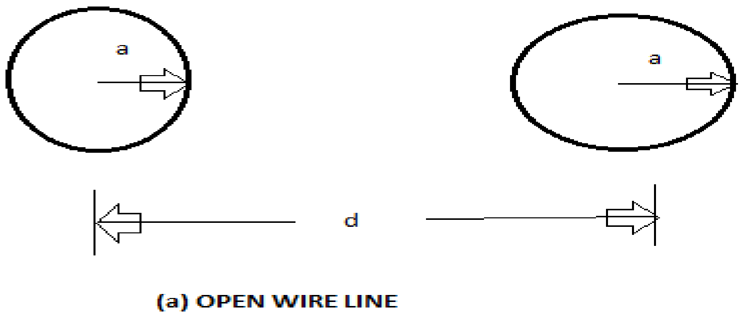

Fig : 2.2.3 Shunt capacitance of Open wire line

In Fig 2.2.3 shows that it consists of two spaced parallel wire supported by insulators; at proper distance to give a desired value of capacitance.

$C = \frac{\pi \, \varepsilon_d}{log_e\left(\frac{d}{a}\right)}$ F/m

ε_d = Permeability of the dielectric

= radius of the conductor

d = distance b/w the conductor

b) FOR COAXIAL CABLE:

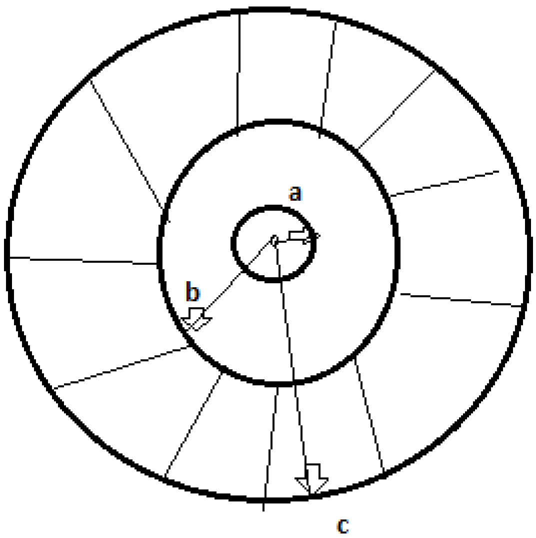

Fig : 2.2.4 Shunt capacitance of Coaxial cable

In Fig 2.2.4,

$C = \frac{2\pi \, \varepsilon_d}{log_e\left(\frac{d}{a}\right)}$ F/m

a = radius of the inner conductor

b = inner radius of the outer conductor

LOOP RESISTSNCE:

a) FOR OPEN WIRE LINE:

In Fig 2.2.5 shows that it consists of two spaced parallel wire supported by insulators; at proper distance to give a desired value of resistance.

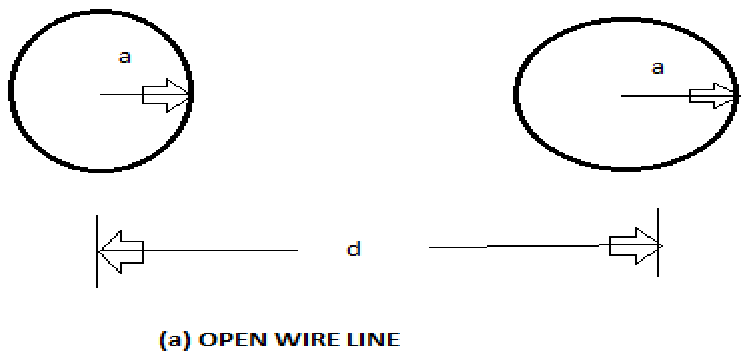

Fig : 2.2.5 Loop resistance of Open wire line

$R_{dc} = \frac{2}{\pi\sigma a^2}$

$R_{ac} = \frac{R_{dc}}{2}$ a $\sqrt{\pi\sigma\mu_c f}$

σ = conductivity

μ_c = permeability of a conductor

f = frequency

a = radius of the conductor

b) FOR COAXIAL LINE:

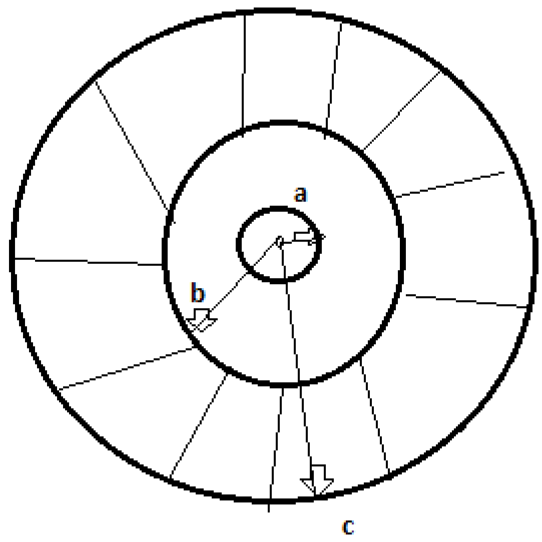

Fig : 2.2.6 Loop resistance of Coaxial cable

In Fig 2.2.6,

$$R_{dc} = \frac{1}{\pi\sigma}\left[\frac{1}{a^2} + \frac{1}{c^2 - b^2}\right]$$

$$R_{ac} = \sqrt{\frac{\mu_c f}{4\pi\sigma}}\left(\frac{1}{a} + \frac{1}{b}\right)$$

All the parameters of R, L, G, C will change with respect to weather condition.