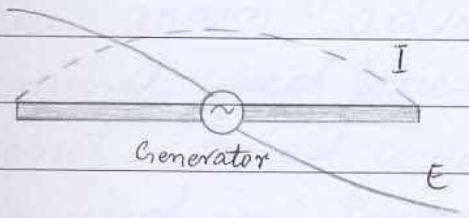
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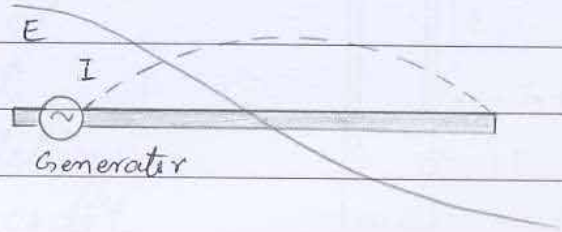
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ANTENNA FEED LINES

* It is usually necessary to transfer energy from the generator (transmitter) to antenna by use of tx-line known as Antenna Feed line, w/c may resonant, non-resonant or combination of both.
* If energy is applied at genetrical centre of an antenna, where high circulatory current is available, known as center feed or current feed.
* If energy is applied at end of an ata where high voltage is available known as End feed or voltage feed.



Center-fed
(Current feed)



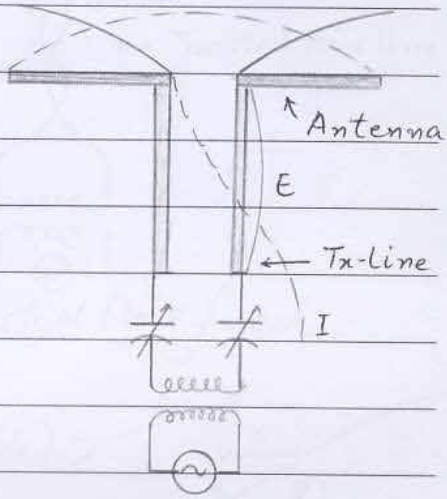
End-fed
(Voltage feed)

Resonant feed Line:

* Resonant tx-line is not widely used as an antenna feed method because it tends to be inefficient & is very critical w.r.t length for a particular operating frequency.

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* In certain high frequency applications resonant feeds sometime prove convenient.
* The current fed anta has a low impedance at centre & voltage feeding tx-line, has standing waves on it.
* A series resonant circuit is used to develop high currents needed to excite line. Adjusting capacitors at o/p compensates for slight irregularities in line & antenna length thus the coaxial line is preferred due to its low radiation loss, is high frequency application.
* To overcome SWR on resonant ata feed line a strong signal needed to transmit, so this a booster is used at feeder.
* The main advantage of resonant feed line is it doesnot need any Z-matching Thus used in Sensors of Aircraft. that are operating at resonant frequency.
* High power losses due to high SWs of current, incl probability of arc-over d/c of high SWs of voltage, very critical length & production of radiation fields by line due to SWs on it are main disadvantages of Resonant ata feed line.

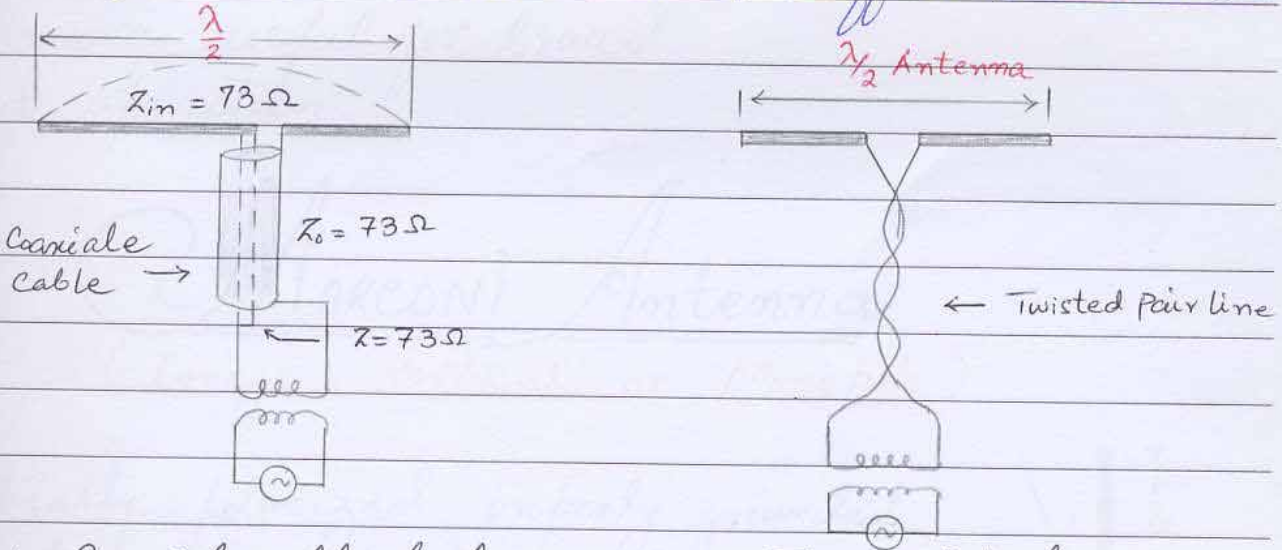


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Non-Resonant Feed Line:

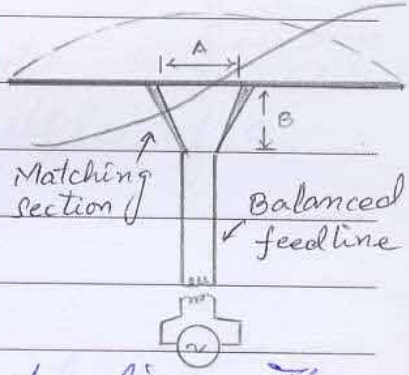
* The non-resonant feed line (properly terminated in its characteristics Z at ata and) is the more widely used technique as its operation is practically independent of its length.

* In non-resonant any length is used thus matching is required for this purpose Balun is included in circuit with different scenerios.



↳ Coaxial cable feed. ↳ Twisted Pair feed.

DELTA Match: (Wide band operatable)

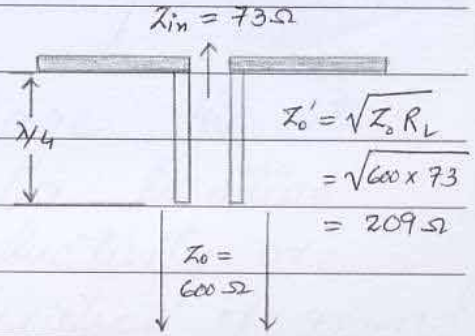


* A half wave dipole does not have to be fed into (at) its mid point. It is possible to feed ata at some distance from centre in both directions. The Δ allows Z to be adjusted to match tx-line. The greater seperation btw connection to ata, higher Z. Just for centre-fed ata, Z is resistive only if ata length is accurate. It is a hit & trial method.

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Quarter Wave Matching: (Narrow band Operatable)

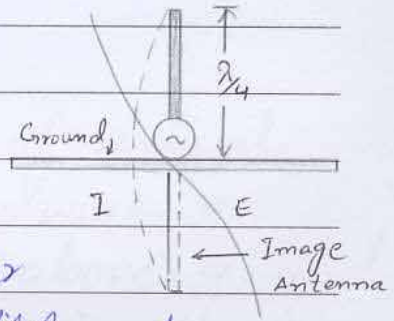
* Quarter wave transformer or matching txfr is used to match low 'Z' of ata to line of higher 'Z' but it will only effective b/w a line and purely resistive load -
* This matching technique is useful for narrow band operation, while delta section is more useful for broad band operation.



Marconi Antenna

(Image, Vertical or Monopole)

* Vertically polarized, properly grounded current ata operating below 2MHz is known as "Marconi Antenna".
* Marconi antenna is usually a quarter wave grounded ata or any odd multiple of a quarter wavelength.



Effects of Ground Reflection:

* This type of anta, by virtue of its connection to ground as other quarter λ, making ~~its~~ the anta electrically a $\frac{1}{2}\lambda$ since Earth is

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→ considered to be a good conductor thus become equivalent radiating partner.

* All of conduction of soil is not similar thus with low conductivity area, reflected wave from ground may be greatly attenuated w/c is undesirable.

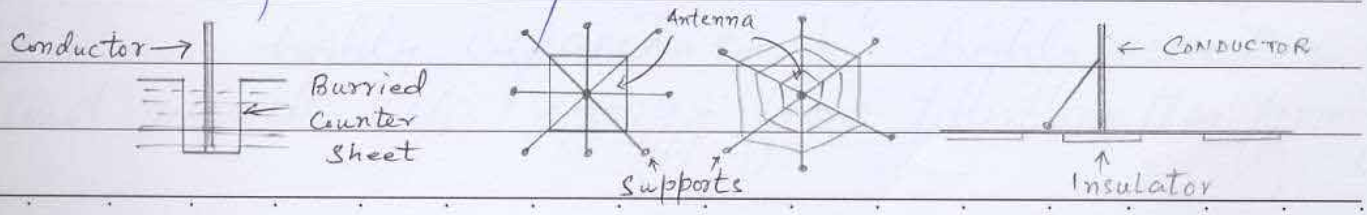
* To overcome this disadvantage, the site location could be moved to a location where soil passes a high conductivity or improve reflecting characteristics of ground by using buried ground screen (Buried Counter sheet) or Counter Poise.

* If it is impractical to move site a large conducting sheet installed in ground to improve the reflected characteristics. Large sheets are sometime difficult to install.

Counter - Poise :

* It is a reflecting surface of vertical ata w/c is a flat structure of wire or screen placed a short distance above ground insulatedly with atleast a quarter λ radius, such as ground & counterpoise act as a capacitor in energising ata.

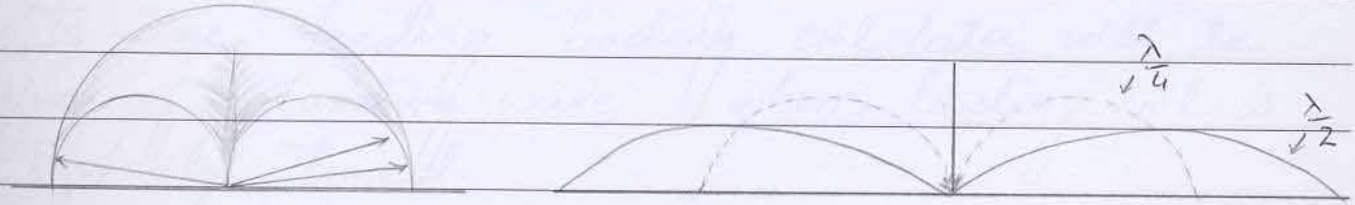
* At high frequency capacitor works as a short circuited & counterpoise will behave same as $\frac{1}{4}$.



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Radiation Pattern:

* The radiation pattern for a Marconi ata is Omni-directional is ground plane but falls to zero off ante's top, thus a large amount of energy is launched as a ground wave but appreciable sky wave energy also exists.
* By increasing vertical height the ground wake strength is also increased & ondd strength is obtainedd as a length slightly less than $5/8\lambda$.
* Any greater length produces high angle radiation of incr strength & horizontal radiation is reduced as Marconi ata is vertically polarized ata. That is why at 1λ height there is no ground wave.



LOADED ANTENNA

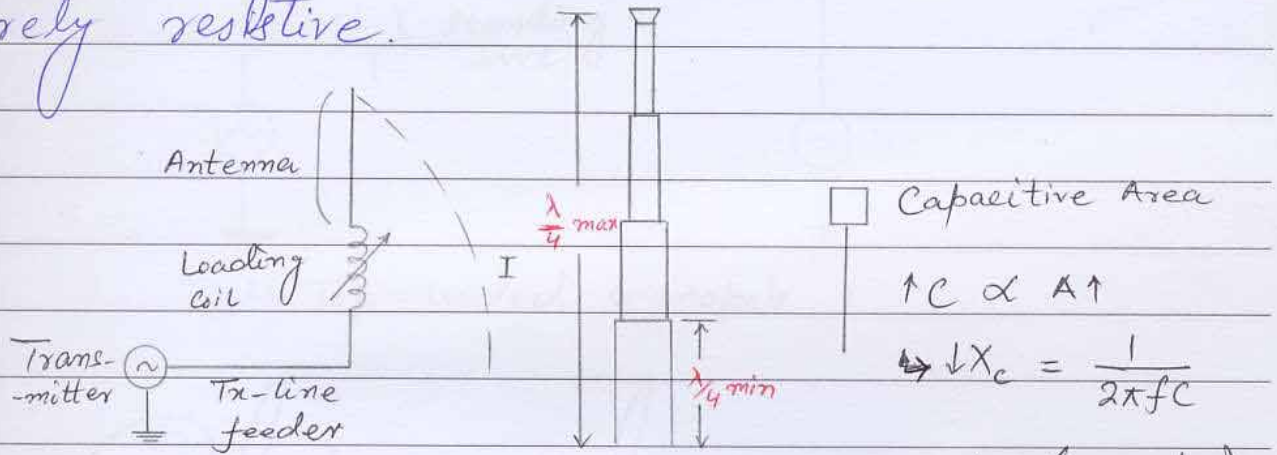
* In many low frequency applications it is not practical to use an ata i.e a full $\frac{\lambda}{4}$ like for mobile transreeciever application.
* Marconi ata less than a $\frac{\lambda}{4}$ have an I/P Z i.e highly capacitive & highly reactive load connot O/P energy from transmitter forming

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→ Standing waves on feeder:

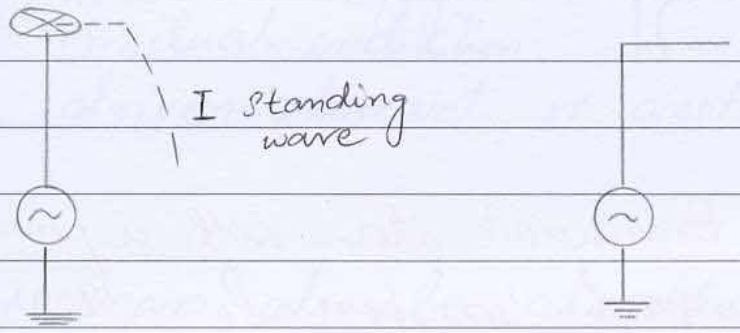
* The effective height of ata should be $\lambda/4$, for this a series inductance, known as loading coil is used to tune out capacitive appearance of an ata and make load purely resistive.



* The standing wave of current has max amplitude at loading coil thus does not add to radiated power resulting in heavy I^2R losses in coil.
* Tx-line feeding loading coil/ata will be free of standing wave when loading coil is properly tuned.
* A more efficient solution is use a top loading ata w/c reduces current standing wave at top of ata & exists at base of ata.
* For this metallic spoked wheel at top of ata adds shunt capacitance to ground, reduces antenna's capacitive reactance.
* The inverted 'L' ata accomplishes same good as top loaded ata but is usually less convenient to physically construct.

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* This does not allow for convenient variable frequency operation as with loading coil, but it is an efficient radiator.

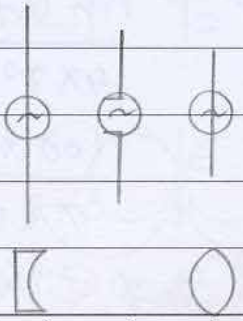


↳ Top-loaded monopole.

Antenna Arrays

* An ata array is formed when two or more ata elements are combined to form a single ata
* An ata element is an individual reflector such as half or $\frac{1}{4}$ λ dipole.
* The elements are placed in such a way that their radiation field interact with each other, producing a total radiation pattern i.e vector sum of individual fields.
* On basis of Element atas can be classified into two types: (1) Driven (2) Parasitic.

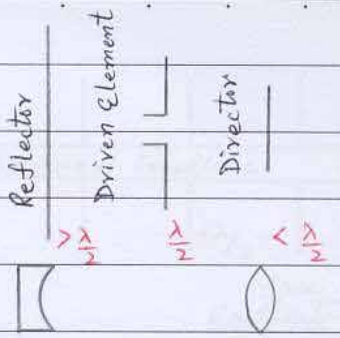
(1) Driven:
Are directly connected to tx-line & recieves power from or driven by source.



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(2) Parasitic :

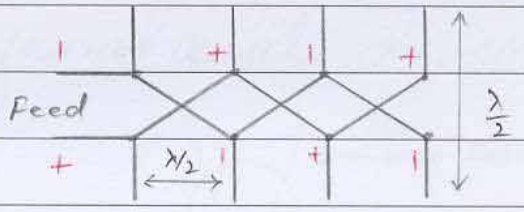
Are those elements w/c are not connected directly to tx-line; they recieve energy only through mutual induction with a driven element or another parasitic element.

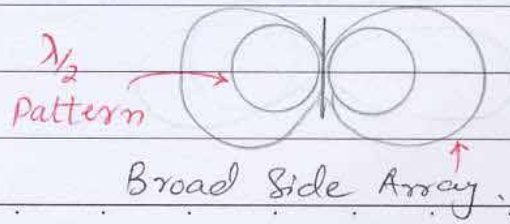


- The arrays can also be classified on the basis of directivity or the radiation pattern in either horizontal or vertical plane, depending on placement of elements.
- If elements are:
  - ↳ Driven: Pattern depends on relative ϕ of feeds.
  - ↳ Not driven: Pattern depends on whether the elements are directors or reflectors.
- The two categories are:
  (1) Broad side array.
  (2) End-fire array.

Broad side array :-

* Made by simply placing several resonant dipoles of equal size in $\parallel$ with each other & in a straight line (collinear).
* All elements are fed in phase from same source.





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Q: For a transmit ata with a power gain $G_t = 10$ and i/p power $P_t = 100W$, determine
(a) EIRP in watt, dBm, dBw (b) P_s at 10km.
(c) Same for Isotropic ata.

Sol

(a) $EIRP = P_t G_t$

$= 100 \times 10$

$EIRP = 1000\ W$

$= 10 \log \frac{1000}{1m}$

$EIRP = +60\ dBm$

$= 10 \log 1000$

$EIRP = 30\ dBW$

(or) $EIRP = 10 \log 1000 + 30\ dB$

$= +60\ dBm$

(b) $P = \frac{P_{in} G_t}{4\pi r^2}$

$= \frac{100 \times 10}{4\pi (100100)^2}$

$P = 0.796\ \mu W/m^2$

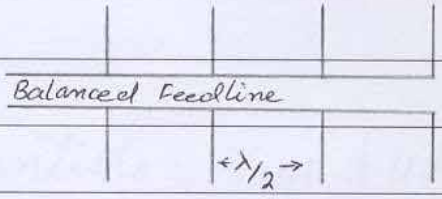
(c) $P = \frac{P_{in}}{4\pi r^2}$

$P = 0.0796\ \mu W/m^2$

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End-fire Array :-

* In this the tx-line is not crisscrossed b/w elements.
* The fields are additive in line with plane of array.





Hertz Antenna with Parasitic Element

* Half-wave dipole ante array consists of a simple Hertz ata & a non-driven half wave element located a quarter λ behind the dipole act as a reflector (Parasitic element that effectively reflects energy from driven element).
* The initial energy from driven element travels a λ/4 before reaching reflectors, equivalent to 90° electrical ϕ shift induces voltage & current but incurs a 180° ϕ shift in induction process. Now reflect back the radiated energy & cover another 90° of ϕ shift making total energy & ϕ shift of 360°. Result constructive interference at driven element.

