... by using following equation-

$$a - r_0 = ae \cos E$$

$$r_0 = a - ae \cos E$$

$$r_0 = a(1 - e\cos E)$$

* ⇒ Calculating value of ϕ_0 from following equation-

$$r_0 = \frac{a(1-e^2)}{1 + e\cos\phi_0}$$

* ⇒ Calculate values of x_0 & y_0 by using following equations-

$$x_0 = r_0 \cos\phi_0$$

$$y_0 = r_0 \sin\phi_0$$

⇒ **Velocity of Satellite:-** * Let us consider satellite moving with velocity v in orbit. The velocity v can be given as bellow-

$$v^2 = \left(\frac{dx_0}{dt}\right)^2 + \left(\frac{dy_0}{dt}\right)^2 \quad \text{------------ (i)}$$

where $x_0 = r_0 \cos\phi_0$ &

$y_0 = r_0 \sin\phi_0$

$$\Rightarrow \quad \frac{dx_0}{dt} = \cos\phi_0 \frac{dr_0}{dt} - r_0 \sin\phi_0 \frac{d\phi_0}{dt} \quad \text{------------ (ii)}$$

$$\Rightarrow \quad \frac{dy_0}{dt} = \sin\phi_0 \frac{dr_0}{dt} + r_0 \cos\phi_0 \frac{d\phi_0}{dt} \quad \text{------------ (iii)}$$

Squaring and adding equation (ii) & (iii), we get

$$v^2 = \left(\frac{dr_0}{dt}\right)^2 + r_0^2 \left(\frac{d\phi_0}{dt}\right)^2 \quad \text{------------ (iv)}$$

We already know that

$$\frac{d^2\vec{r_0}}{dt^2} = -\frac{\mu}{r_0^3}\vec{r_0} = -\frac{\mu}{r_0^2}\hat{r_0} \quad \text{------ (v)}$$

differentiating (v) we get

$$\frac{d}{dt}\left\{\frac{d^2\vec{r_0}}{dt^2}\right\} = \frac{d}{dt}\left\{-\frac{\mu}{r_0^3}\vec{r_0}\right\}$$

$$= -\frac{\mu}{r_0^3}\frac{d\vec{r_0}}{dt}\cdot\vec{r_0}$$

or $$\frac{1}{2}\frac{d}{dt}\left\{\frac{d\vec{r_0}}{dt}\cdot\frac{d\vec{r_0}}{dt}\right\} = -\frac{\mu}{r_0^2}\frac{d\vec{r_0}}{dt}\vec{r} = -\frac{\mu}{r_0^2}\frac{dr_0}{dt}$$

------ (vi)

Integrating equation (vi), we get

$$\frac{1}{2}\frac{d\vec{r_0}}{dt}\cdot\frac{d\vec{r_0}}{dt} = \frac{\mu}{r_0} + c$$

$$\frac{1}{2}v^2 = \frac{\mu}{r_0} + c = \frac{1}{2}\left(\frac{dr_0}{dt}\right)^2 + \frac{1}{2}r_0^2\left(\frac{d\phi_0}{dt}\right)^2$$

------ (vii)

But at perigee $\frac{dr}{dt} = 0$ and $r_0 = a(1-e)$, Hence equation (vii) becomes-

$$r_0^2\left(\frac{d\phi_0}{dt}\right)^2 = \frac{h^2}{r_0^2}$$

$$\therefore \frac{\mu}{r_0} + c = 0 + \frac{1}{2}r_0^2\left(\frac{d\phi_0}{dt}\right)^2$$

$$\frac{\mu}{a(1-e)} + c = \frac{1}{2}\frac{h^2}{r_0^2} = \frac{1}{2}\frac{h^2}{a^2(1-e)^2}$$

$$= \frac{1}{2}\frac{\mu p}{a^2(1-e)^2}$$

$$\therefore c = \frac{1}{2}\frac{\mu p}{a^2(1-e)^2} - \frac{\mu}{a(1-e)} = -\frac{\mu}{2a}$$

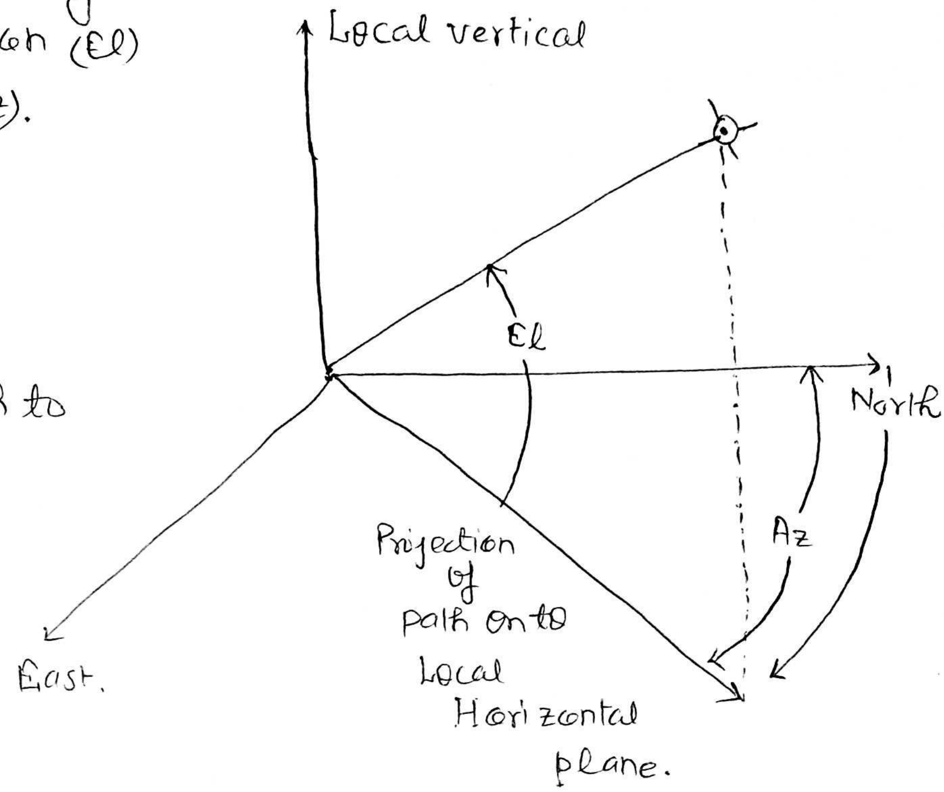
$$\Rightarrow \frac{1}{2}v^2 = \frac{\mu}{r_0} + c = \frac{\mu}{r_0} - \frac{\mu}{2a}$$

$$v^2 = 2\mu\left[\frac{1}{r_0} - \frac{1}{2a}\right] \Rightarrow \boxed{v^2 = 2\mu\left\{\frac{1}{r_0} - \frac{1}{2a}\right\}}$$

⇒ Look Angles :- "The co-ordinates to which an earth station antenna must be pointed to communicate with a satellite are called look angles."

These are most commonly expressed as elevation (El) and azimuth (az) (AZ).

Azimuth is measured clockwise (eastward) from geographic north to the projection of the satellite path on a Local horizontal plane at the earth. station to the satelitte path.



. Elevevation angle and Azimuth angle.

⇒ Subsatellite Point :-

The subsatellite point is the location on the surface of the earth that lies directly between satellite and the centre of the earth. It is nadir pointing direction from the satellite and for a satellite in an equatorial orbit, It will always be located on the equator.

→ The elevation angle measured upward from the Local Horigontal at the earth station.

while.

→ The azimuth angle is measured from true north in an eastward directio to the projection of the satellite pa onto Local Horizontal path.