UNIT - V. CAM'S

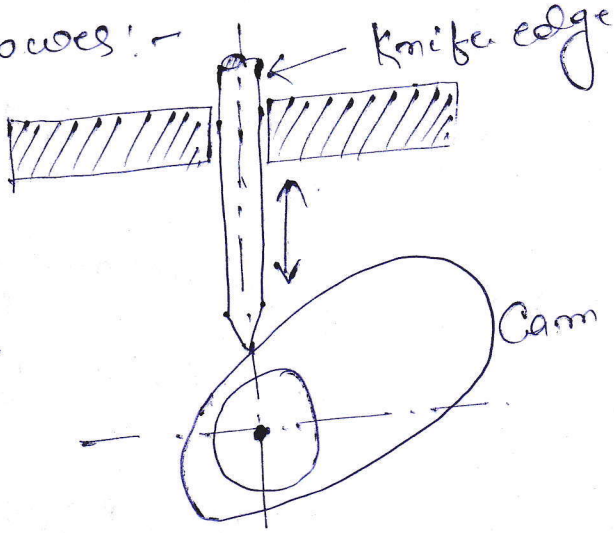
A Cam is a rotating m/c element which gives reciprocating or oscillating motion to another element known as followes.

The cam and followes have a line contact and constitute a highes pair. The cams are widely used for operating the inlet and outlet (exhaust) valve of internal combustion engines, automatic attachments of machineries, Paper cutting m/c, spining and weaving textile machineries, Feed mechanism of automatic lathes.

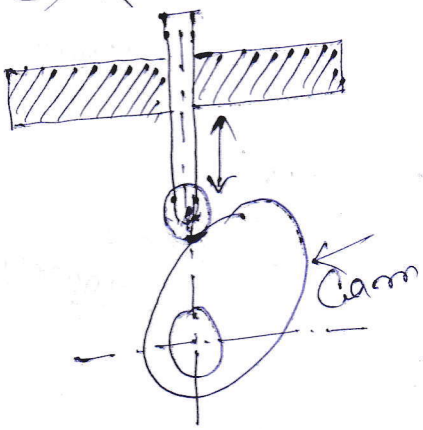
⇒ Types of followers

(i) According to the Suface in Contact.

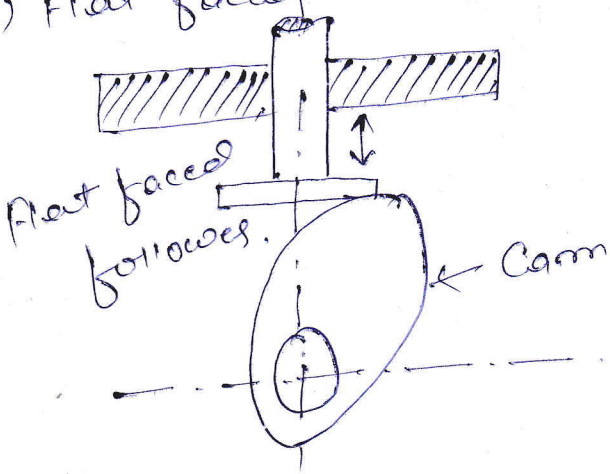
(a) Knife edge followes:-



(b) Rolles followes:-

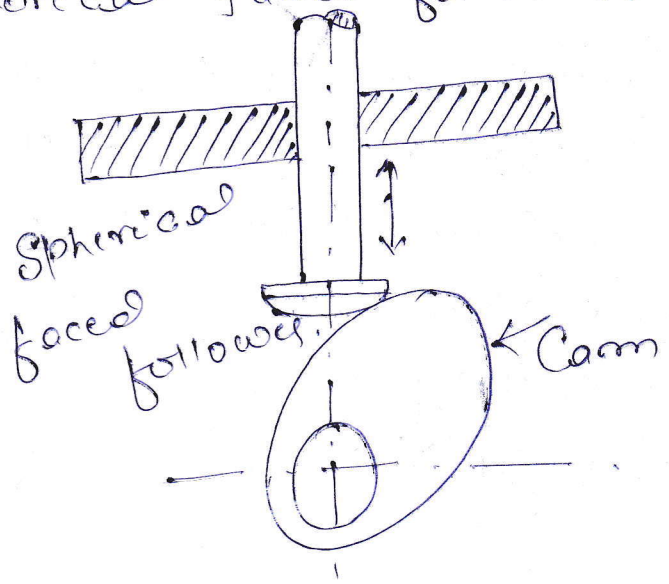


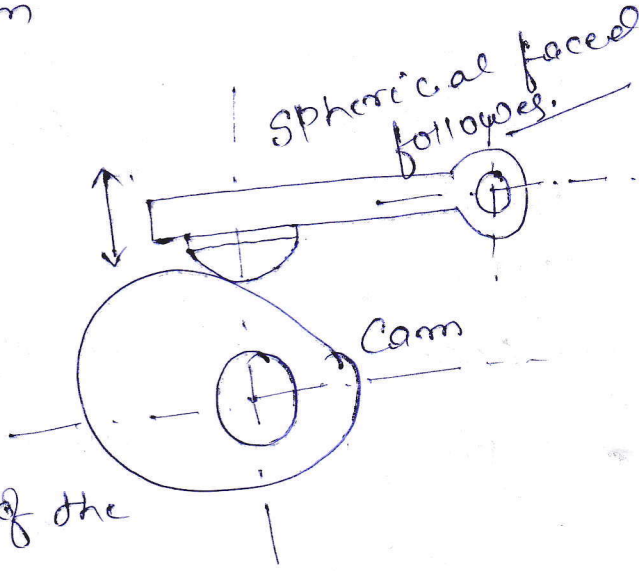
(c) Flat faced or mushroom followes.



when the flat faced followes is Circulas, Then it is Called a mushroom followes.

(d) Spherical faced followes:-





(2) According to the motion of the followes.

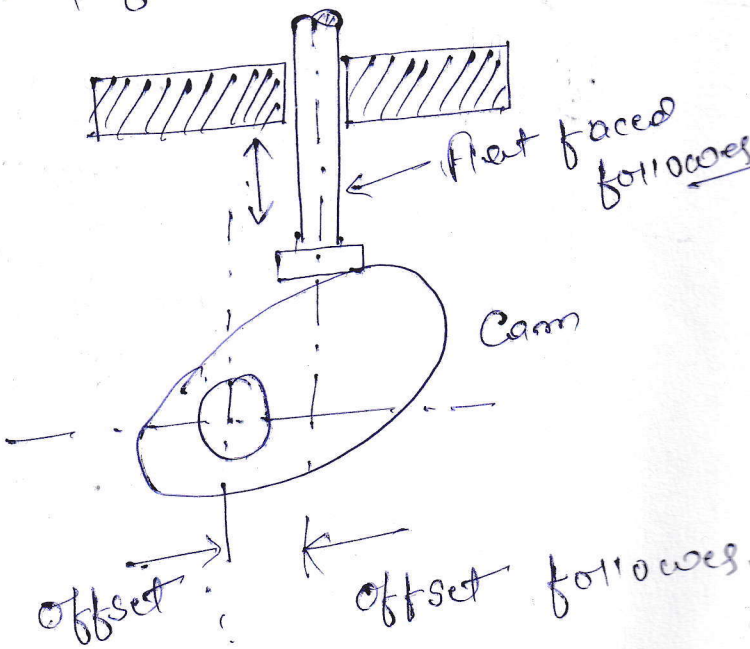
(a) Reciprocating or Translating followes.

(b) Oscillating or Rotating followes.

(3) According to the Path of the motion of followes

(a) Radial followes.

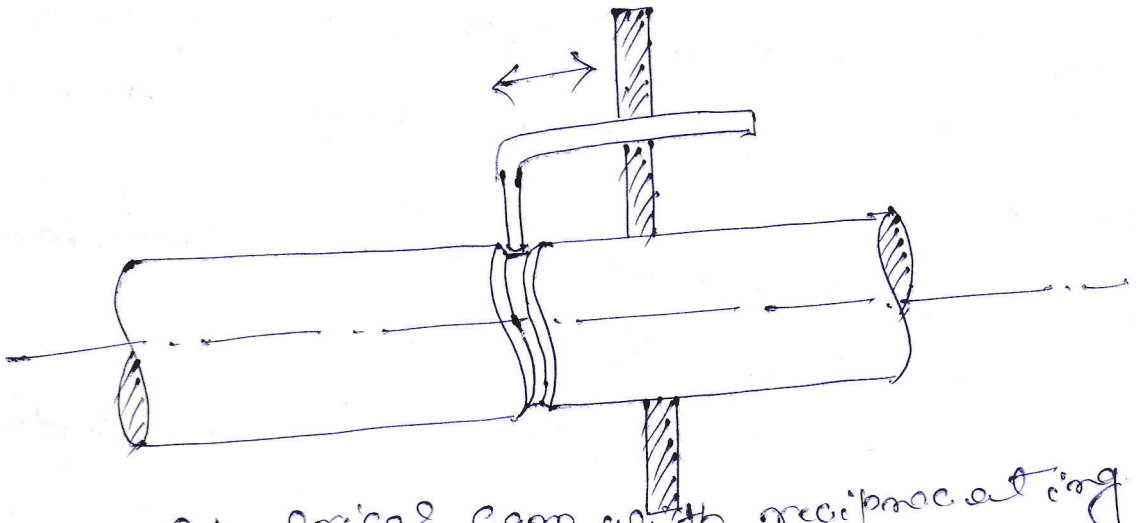
(b) Off. set followes.



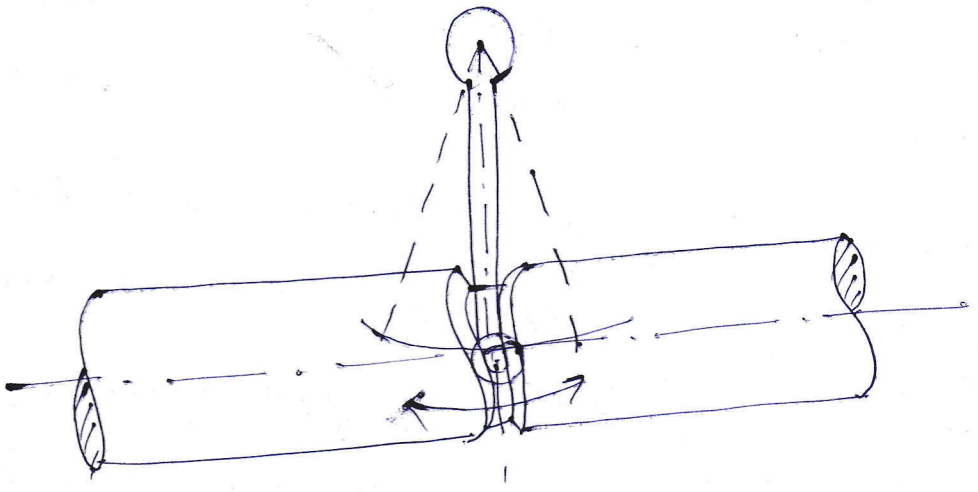
⇒ Types of Cams.

(i) Radial or disc Cam:— In radial cams, the follower reciprocates or oscillates in a direct perpendiculars to the cam axis. The types of follo wes according to the surface contact is known as Radial or disc cam.

(ii) Cylindrical Cam:— In cylindrical cams, the follower reciprocates or oscillates in a direc ion parallel to the cam axis.



Cylindrical cam with reciprocating follower.



Cylindrical cam with oscillating follower.

⇒ Terms used in Radial Cams.

(i) Base Circle :- It is the Smallest Circle that Cam drawn to the Cam Profile.

(ii) Trace Point :- It is a reference Point on the fo wes and is used to generate the Pitch Curve. In Case of Knife edge followes the Kn edge is represent a trace point. but in Case of rolles followes the Centre Point of the rolles is Kno as Trace Point.

(iii) Pressure angle :- It is the angle between the direction of the followes and a normal to the Pitch Curve.

(iv) Pitch Point :- It is a Point on the Pitch Curve hav the maximum Pressure angle.

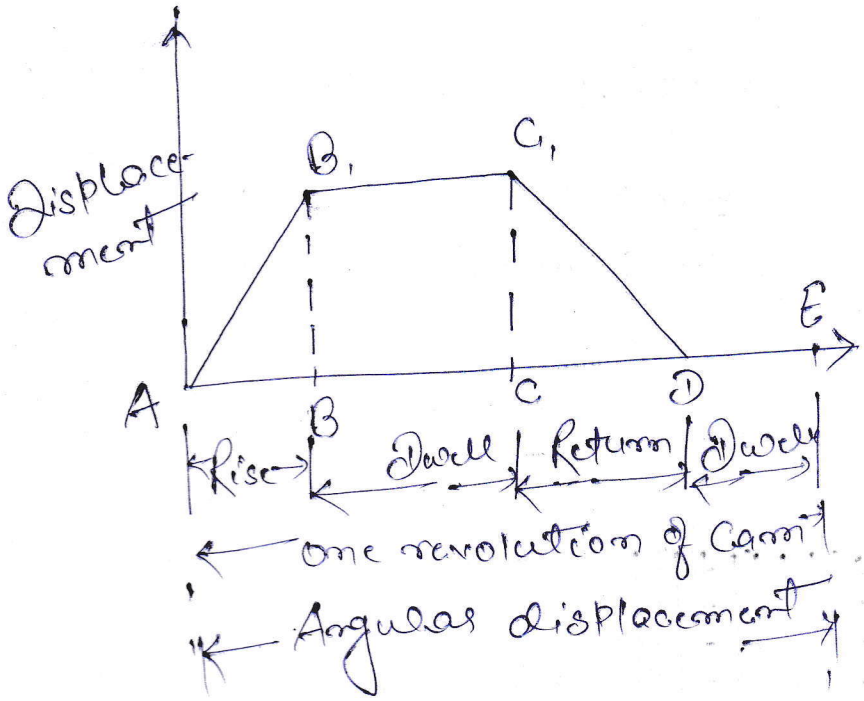
(v) Pitch Circle :- It is a Circle drawn from the Centr of the Cam through the Pitch Points.

(vi) Pitch Curve :- It is the Curve generated by the trac Point as the followes moves relative to the Cam.

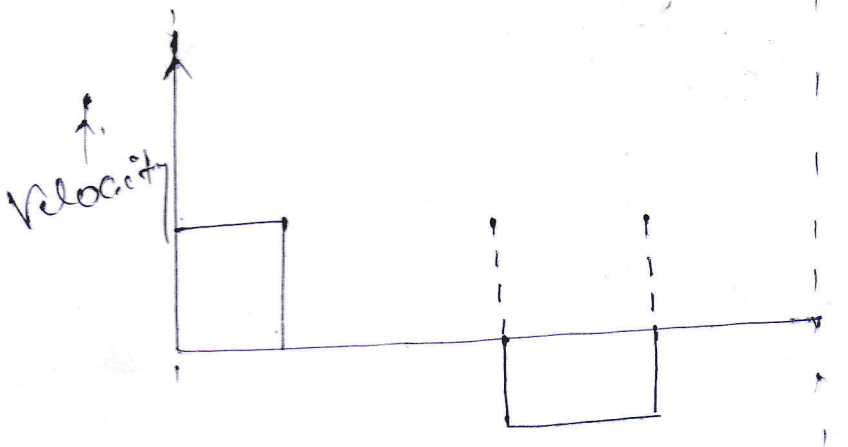
(vii) Prime Circle :- It is the Smallest Circle drawn from the Centre of the Cam and tangent to the Pitch Curve. for a knife edge and flat faced followes the Prime Circle and the base Circle are identical. for a rollas followes, the Prime Circle is lasges than th base Circle by the radius of the rollas.

(viii) Lift of stroke :- It is the maximum travel of the follower from its lowest position to the topmost position.

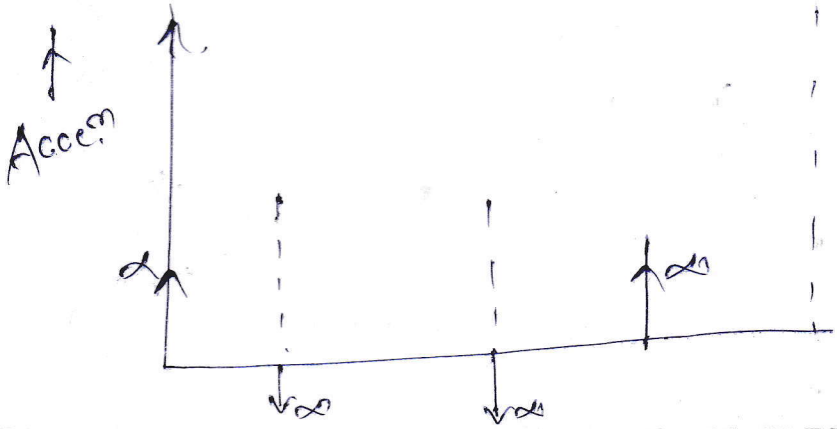
⇒ (i) uniform velocity :-



Displacement diagram.



velocity diagram.



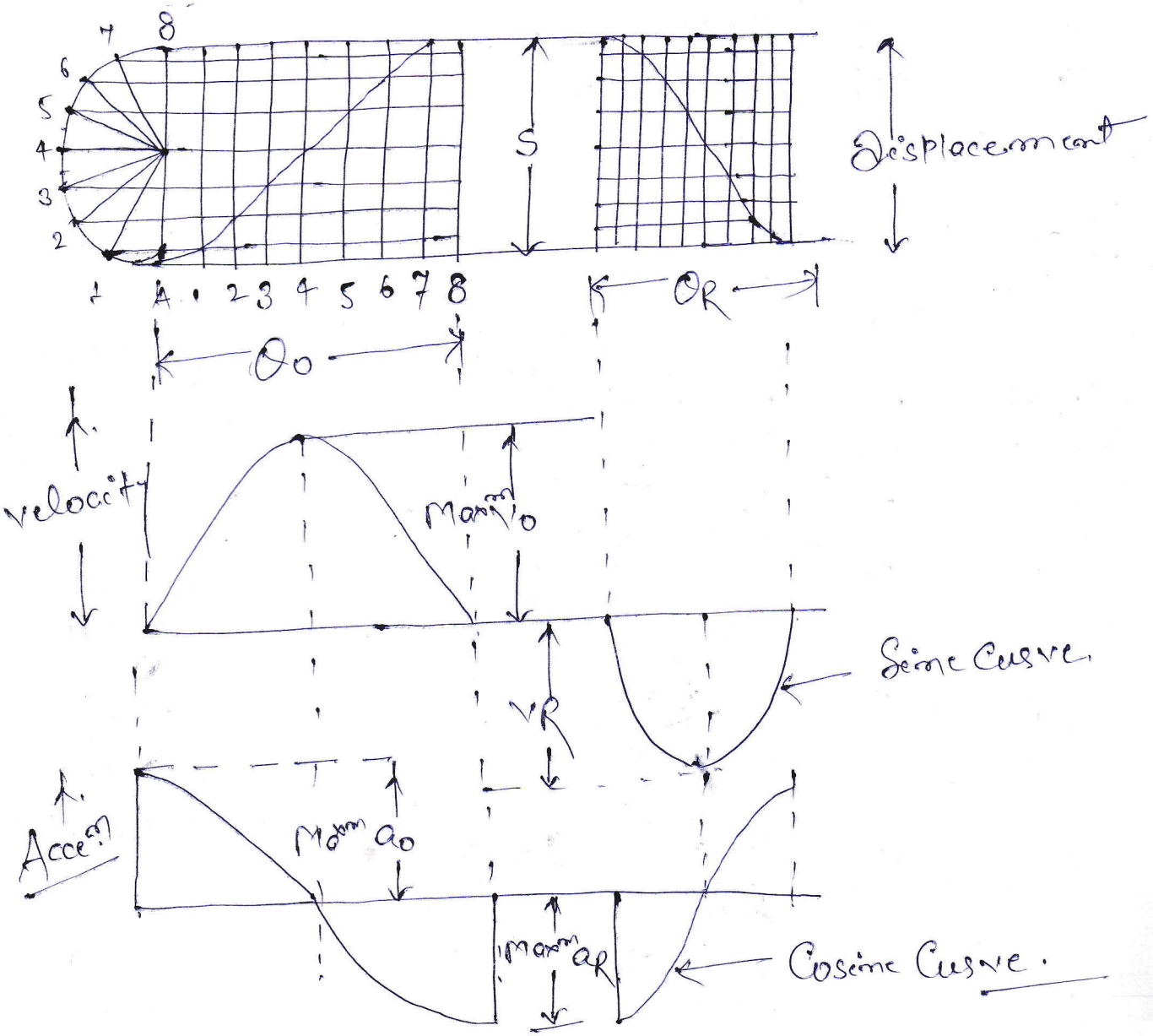
Acceleration diagram.

The follower moves with uniform velocity during its rise and return stroke. So by this reason the displacement curve must be constant.

The Periods during which the followers remains at rest are known as dwell Period.

⇒ (2) Simple harmonic motion:— The displacement velocity and Acceleration diagrams when follower moves with simple harmonic motions.

Displacement diagram.



Let S = Stroke of the followes

θ_o = Angules displacement of the Cam during out stroke.

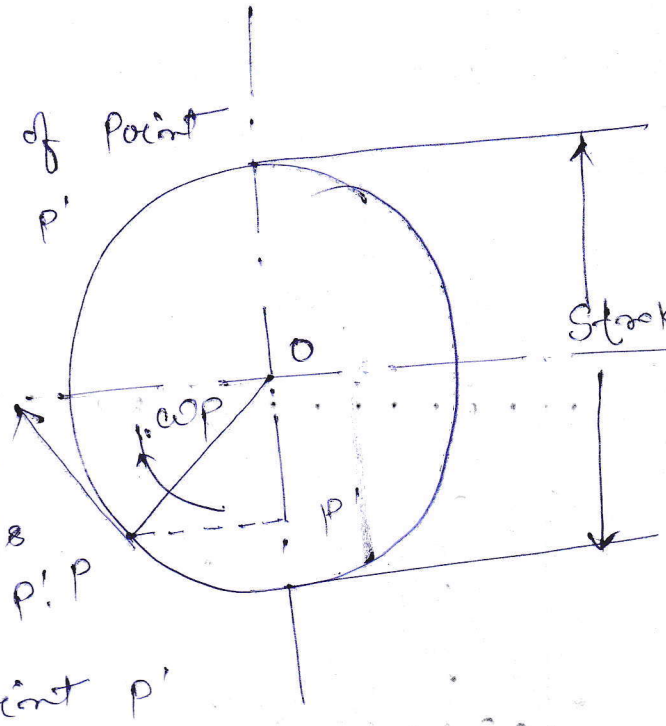
θ_R = Angules displacement of Cam during Rest Stroke.

ω = Angules velocity of the Cam (rad/s).

∴ Time required for the out stroke of the followes in Seconds

$$\boxed{t_o = \frac{\theta_o}{\omega}}$$

Point P' is the Projection of Point P on the diameter. Point P' executes a simple harmonic motions as the point P rotates.



The motion of the followes is Similas to that of Point P' P

∴ Peripheral Speed of the Point P'

$$V_p = \frac{\pi S}{2} \times \frac{1}{t_o} = \frac{\pi S}{2} \times \frac{\omega}{\theta_o}$$

Maxm velocity of the followes on the outstroke

$$V_o = V_p = \frac{\pi S}{2} \times \frac{\omega}{\theta_o} = \frac{\pi \omega S}{2\theta_o}$$

∴ Maxm Accen of the followes on the outstroke

$$a_o = a_p = \frac{\pi^2 \omega^2 S}{2(\theta_o)^2}$$

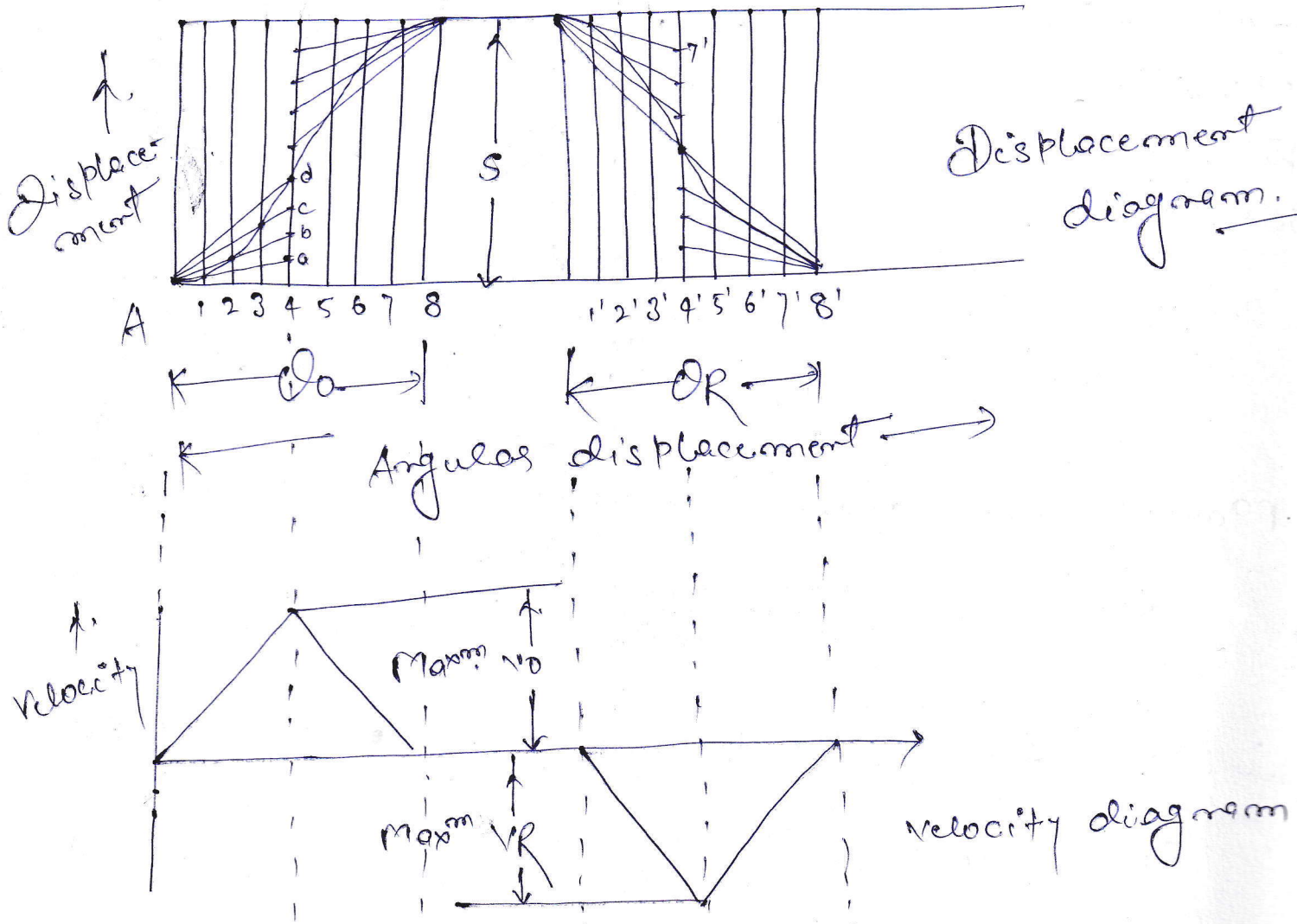
Similarly, Maxm velocity of the follower on the return stroke,

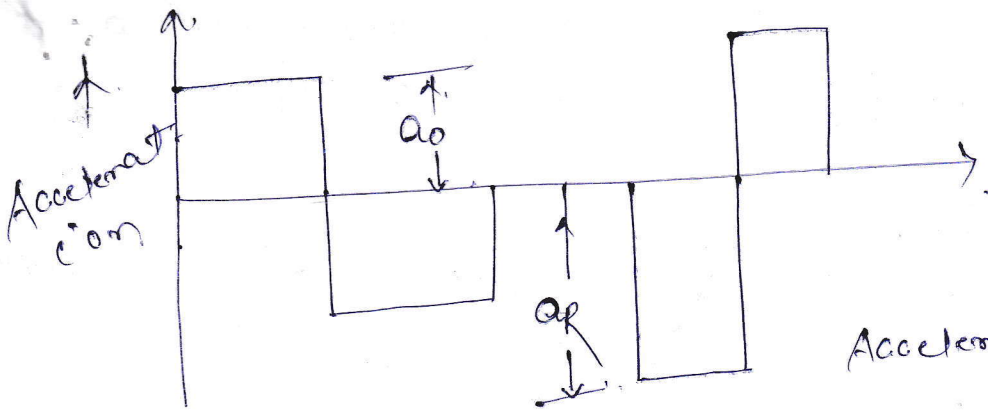
$$V_R = \frac{\pi \cdot \omega \cdot s}{2\theta_R}$$

and Maxm Acceleration of the follower on the return Stroke,

$$a_R = \frac{\pi^2 \omega^2 s}{2(\theta_R)^2}$$

(3) Displacement, velocity and Acceleration diagram when the follower moves with uniform acceleration and retardation.





Acceleration diagram.

Time required for the followes during out-stroke.

$$t_o = \theta_o / \omega$$

Similarly for Return stroke

$$t_R = \theta_R / \omega$$

Mean velocity of the followes during outstroke.

$$= \left(S / t_o\right)$$

Similarly for Return stroke.

$$= \left(\frac{S}{t_R}\right)$$

Maximum velocity of the followes is equal to twice the mean velocity.

Maxm velocity of the followes during outstroke.

$$v_o = 2 \times \left(S / t_o\right) = 2\omega S / \theta_o$$

Similarly for Return Stroke.

Maxm velocity.

$$v_R = 2 \times \left(\frac{S}{t_R}\right) = 2\omega . S / \theta_R$$

The maximum velocity of the follower is reached aft
the time $(t_o/2)$ during outstroke and $(t_R/2)$ duri
return stroke.

∴ Maximum acceleration of the follower during outs

$$a_o = \frac{v_o}{(t_o/2)} = \frac{2 \times 2\omega s}{t_o \cdot \theta_o} = \frac{4\omega^2 s}{(\theta_o)^2}$$

Similarly maxm acceleration during return stroke
is

$$a_R = \frac{v_R}{(t_R/2)} = \frac{2 \times 2\omega^2 s}{(\theta_R)^2} = \frac{4\omega^2 s}{(\theta_R)^2}$$