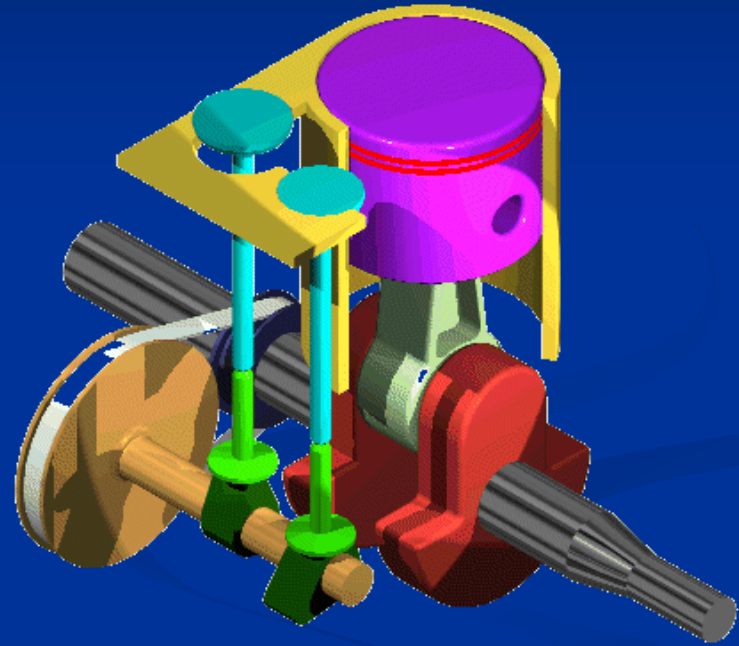
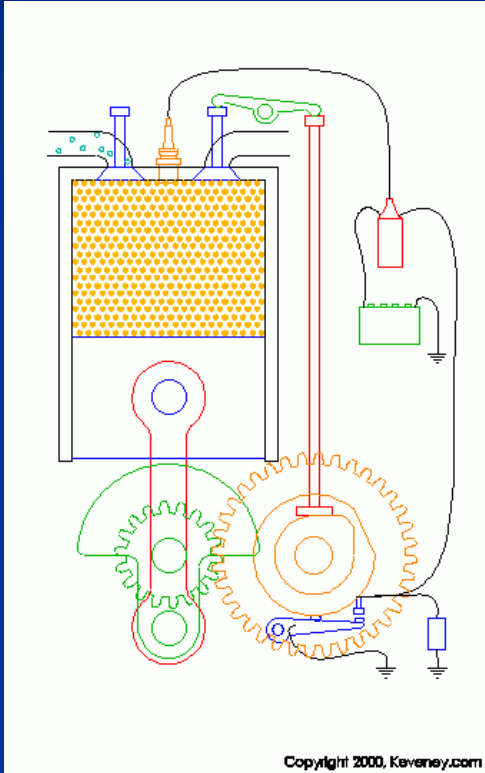


Kinematics of Machines

(NME-502)

Unit – III

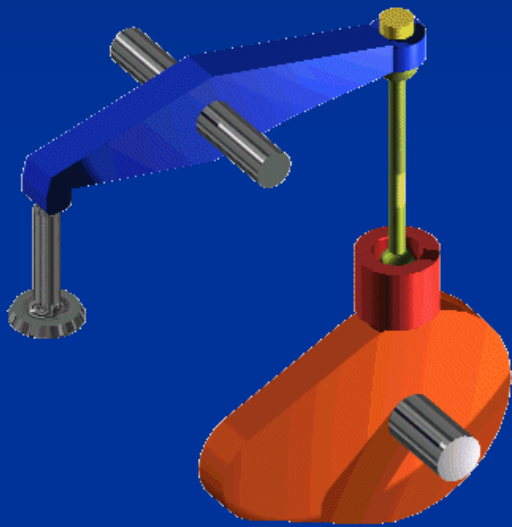
Cam & Follower



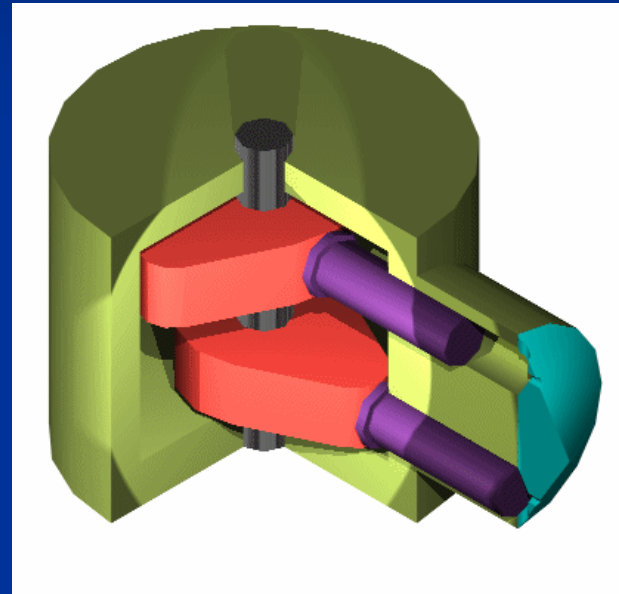
- In IC engines to operate the inlet and exhaust valves

Cam and Follower

Examples of a Rotary cams in operation.



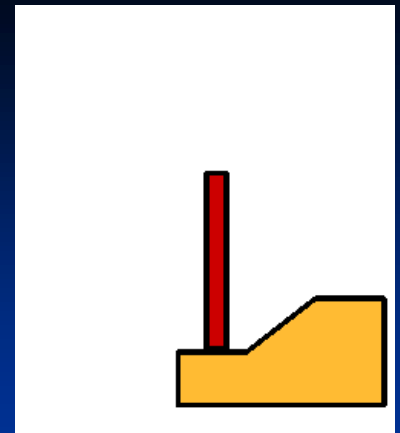
*Control the movement
of the engine valves.*



*Cams used in a
pump.*

Cam and Follower

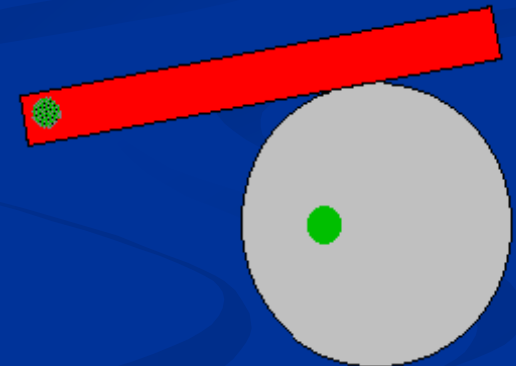
- The **cam and follower** is a device which convert rotary motion or reciprocating motion to rotating , reciprocating or oscillating motion



Cam
s



Follower
s
(valves)

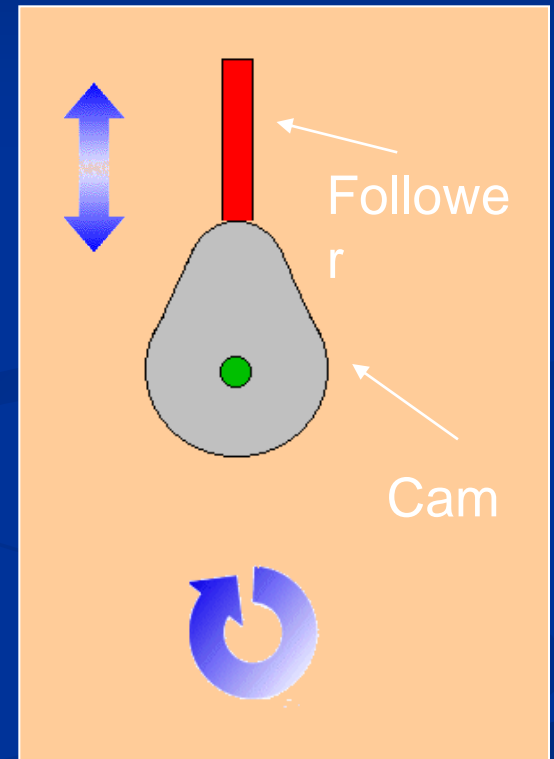
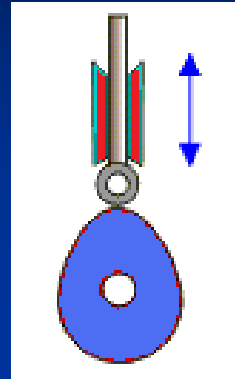


Elements

1. Cam

2. Follower

3. Frame



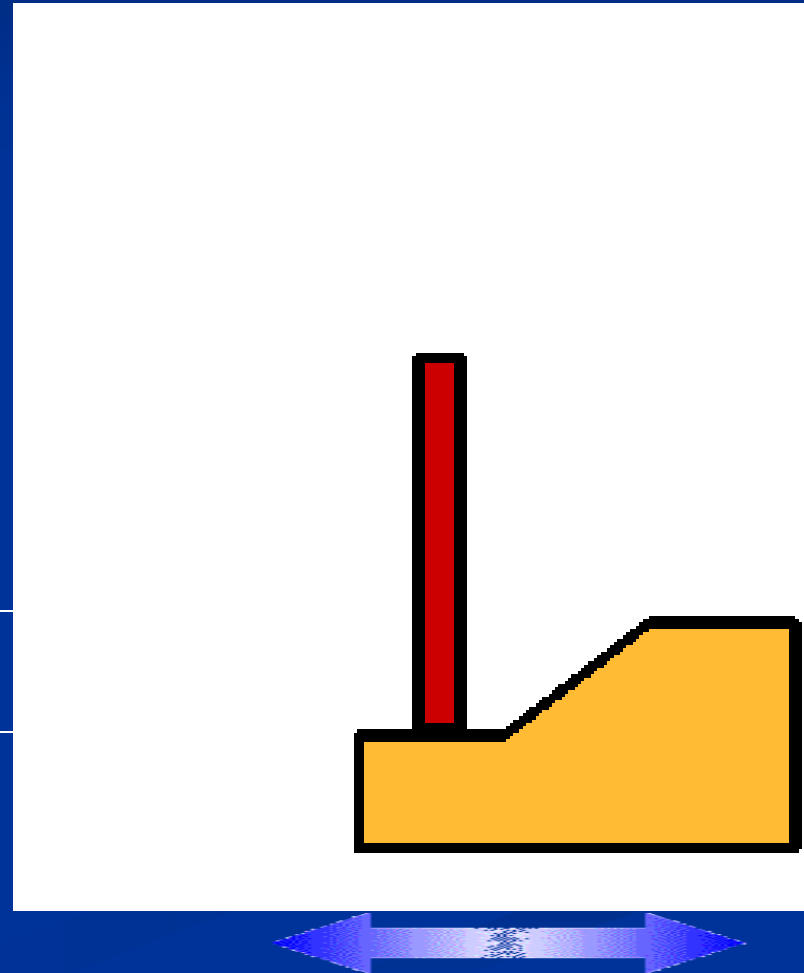
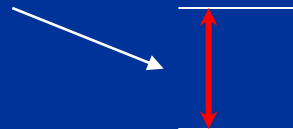
a) Wedge Cam and Follower

- *The wedge cam moves backwards and forwards in a reciprocating motion.*

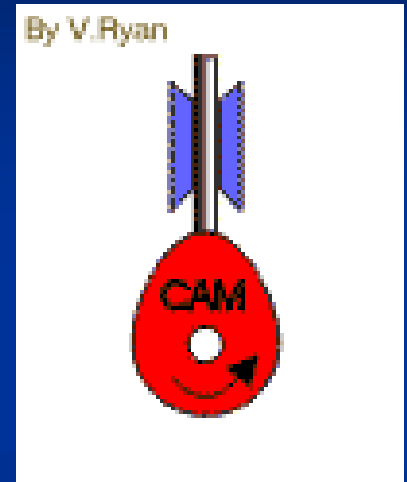
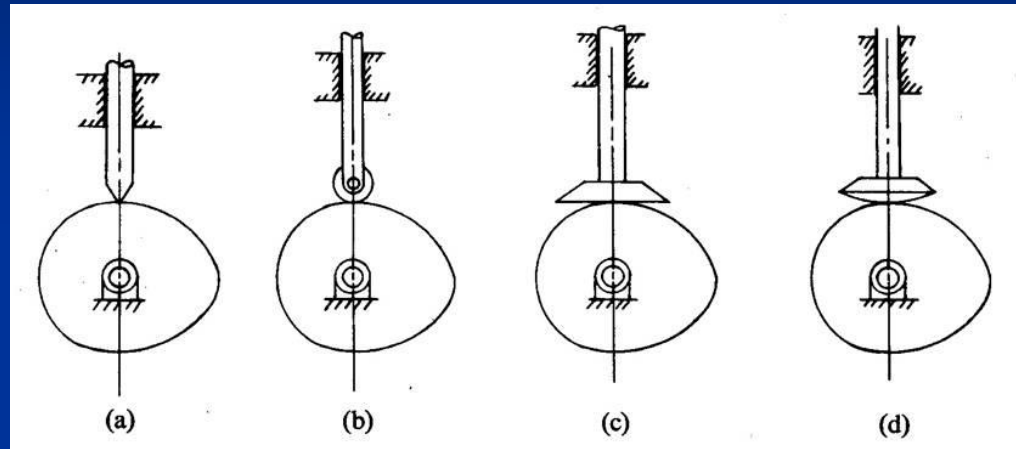
Wedge cam

Cam Follower

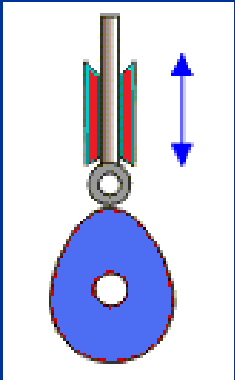
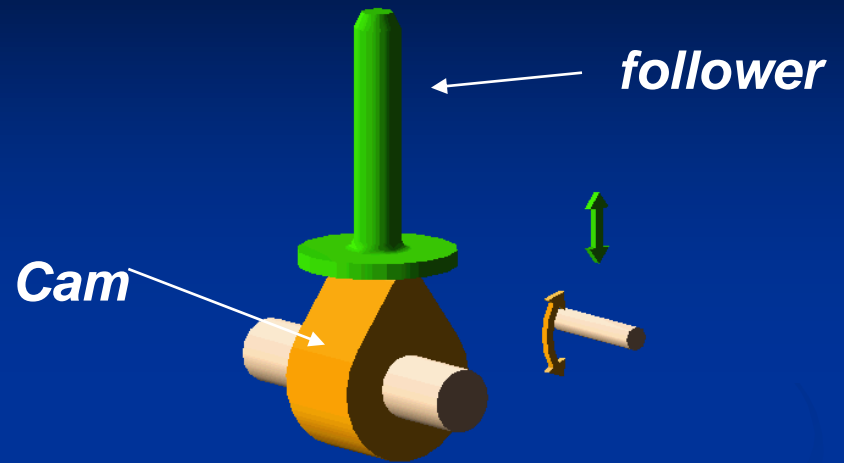
Distance
moved by
the
follower



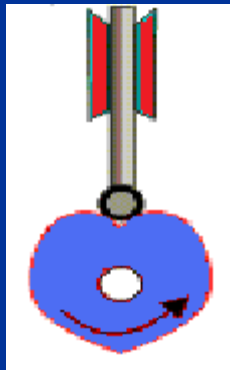
b) Radial or Disc cam



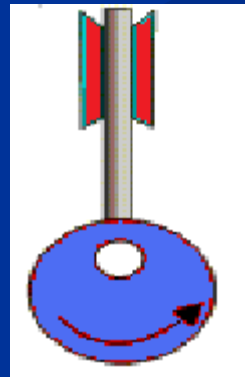
In radial cams, the follower reciprocates or oscillates in a direction perpendicular to the cam axis.



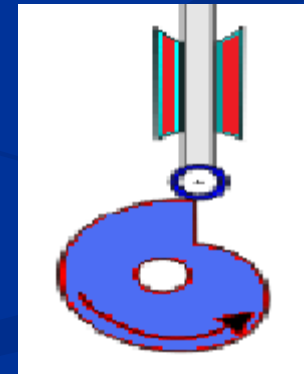
Pear



Heart

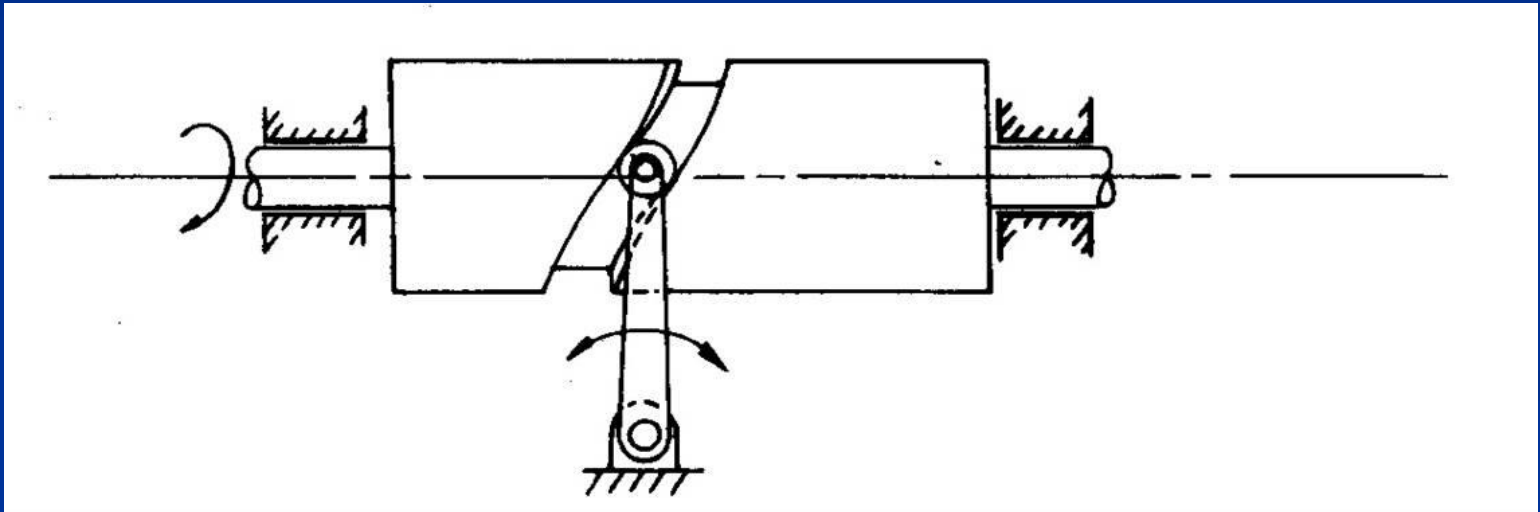


Circular



Drop

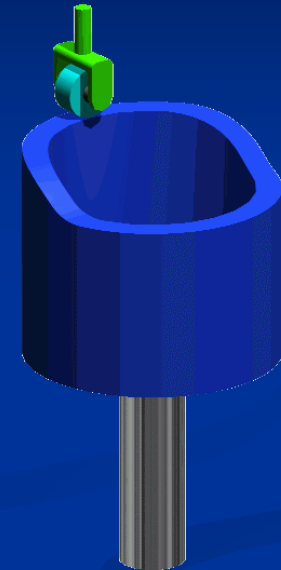
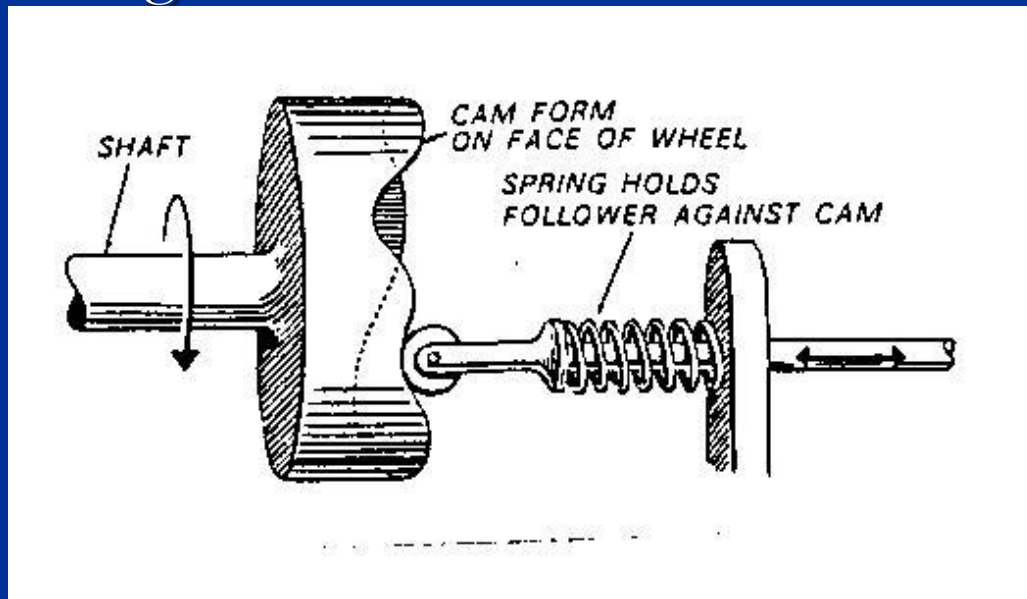
c) Cylindrical cams



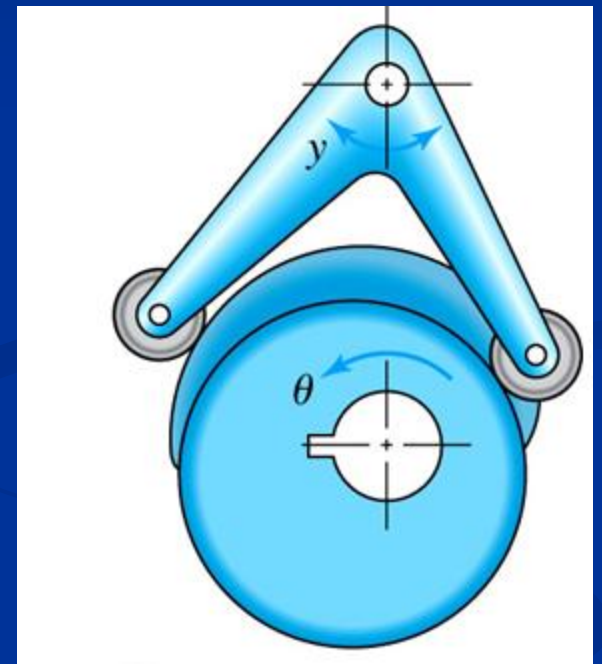
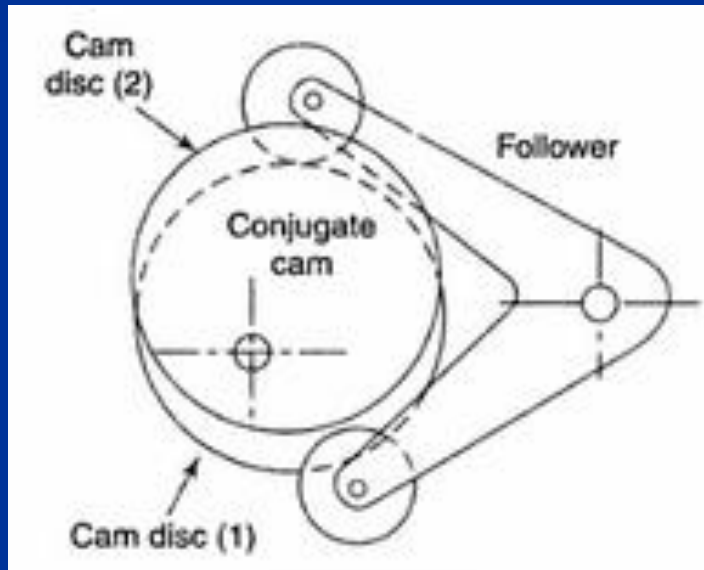
In cylindrical cams, the follower reciprocates or oscillates in a direction parallel to the cam's axis.

d) End OR Face cams

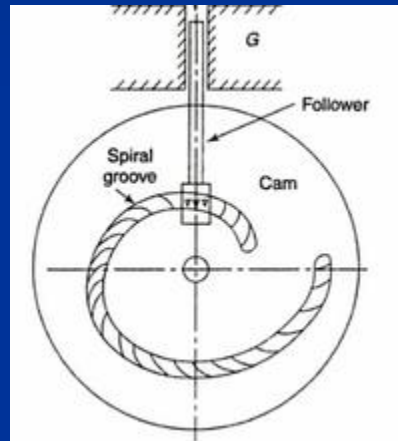
It is also similar to cylindrical cams, but the follower makes contact at periphery of the cam as shown in fig



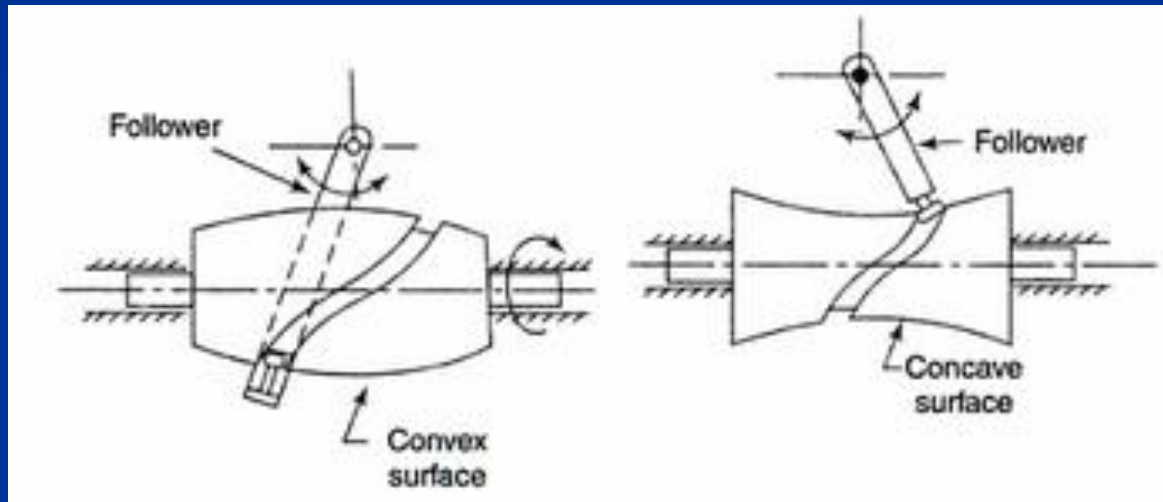
e) Conjugate cam



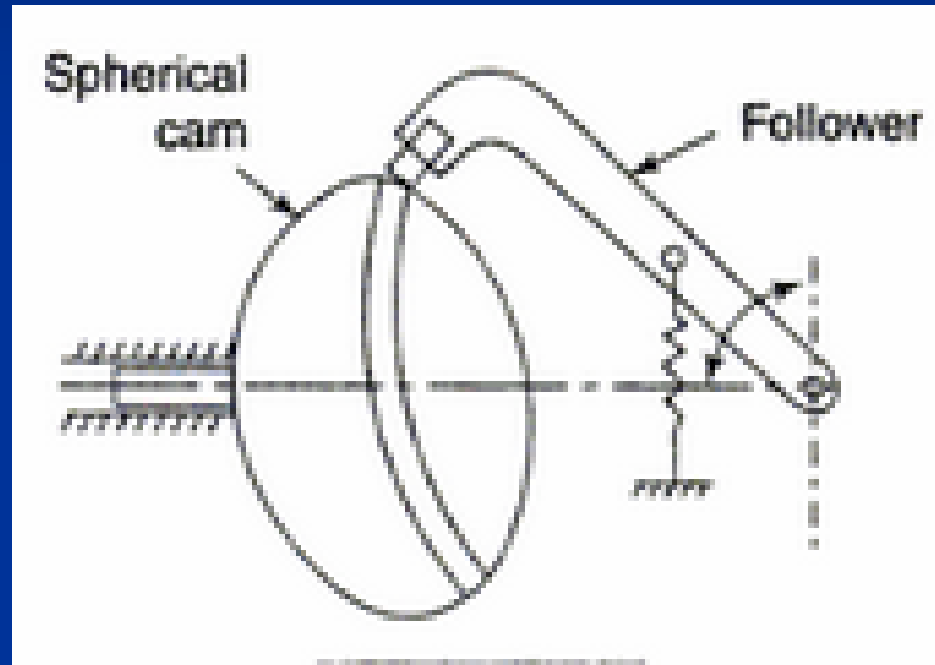
g) Spiral Cam



Globoidal Cam



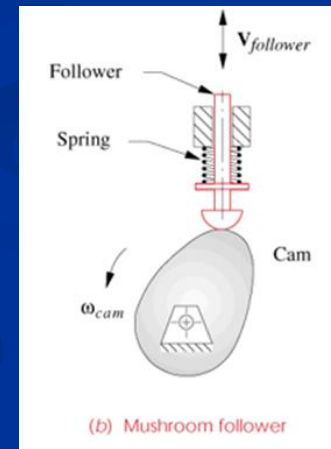
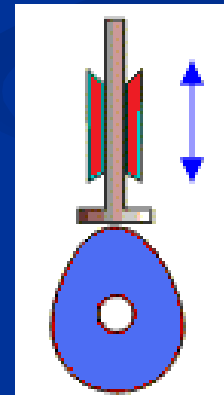
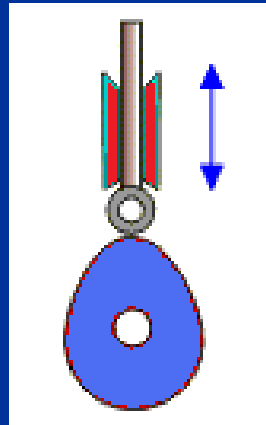
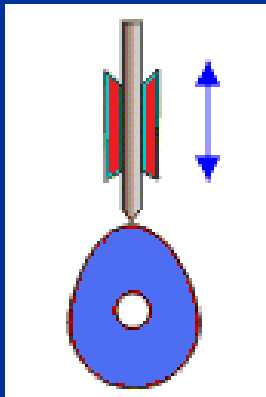
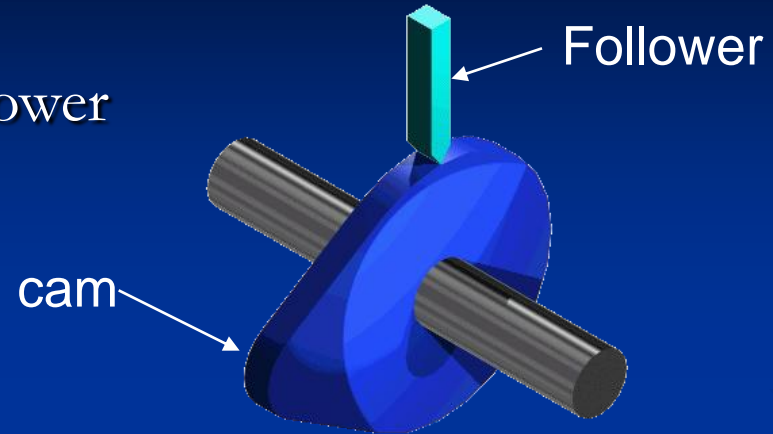
Spheroidal Cam



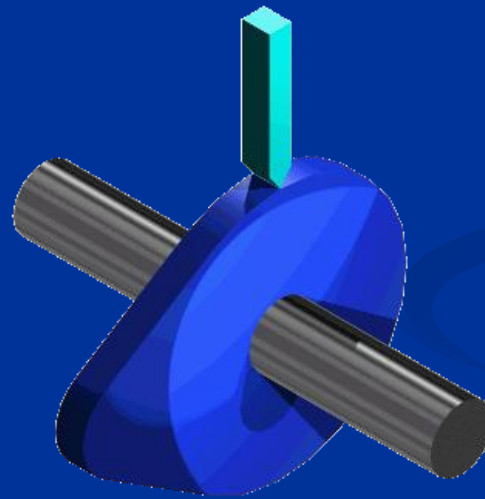
Follower

1. According to the shape of follower

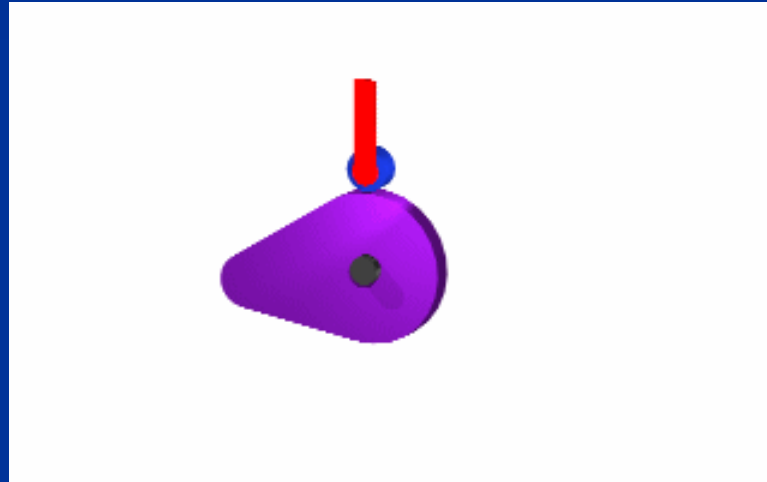
- Knife edge follower
- Roller follower
- Flat faced follower
- Spherical faced follower



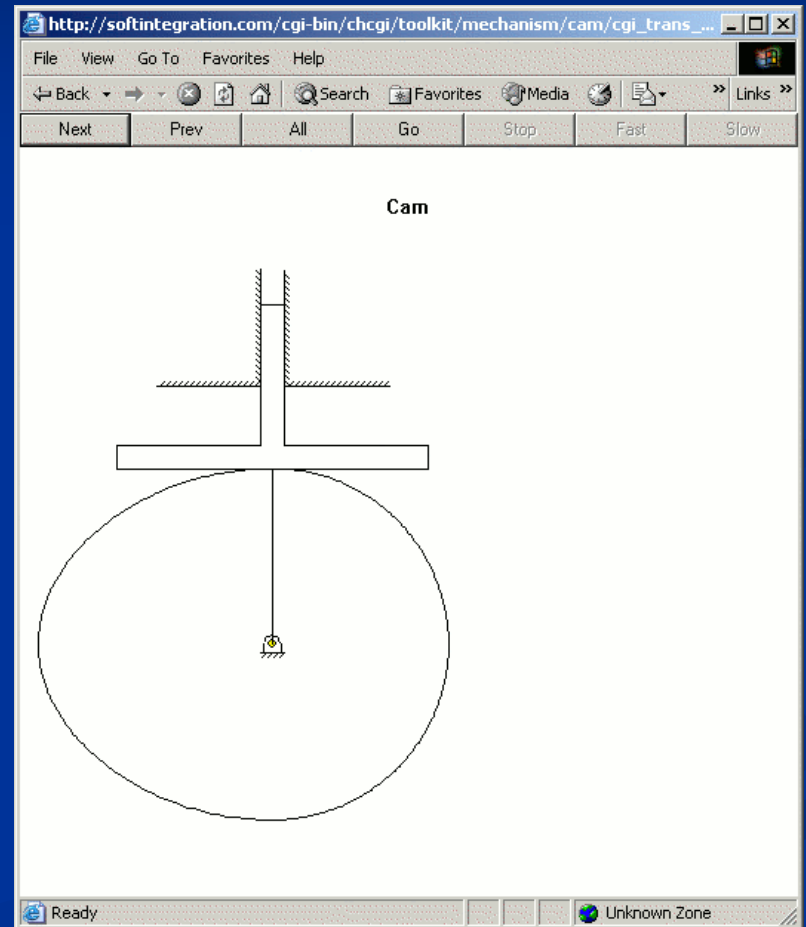
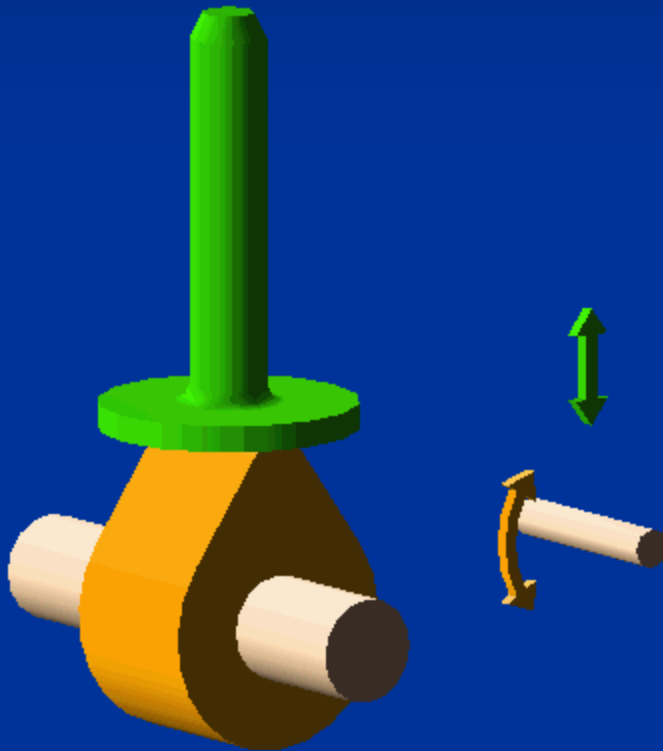
a) Knife edge follower



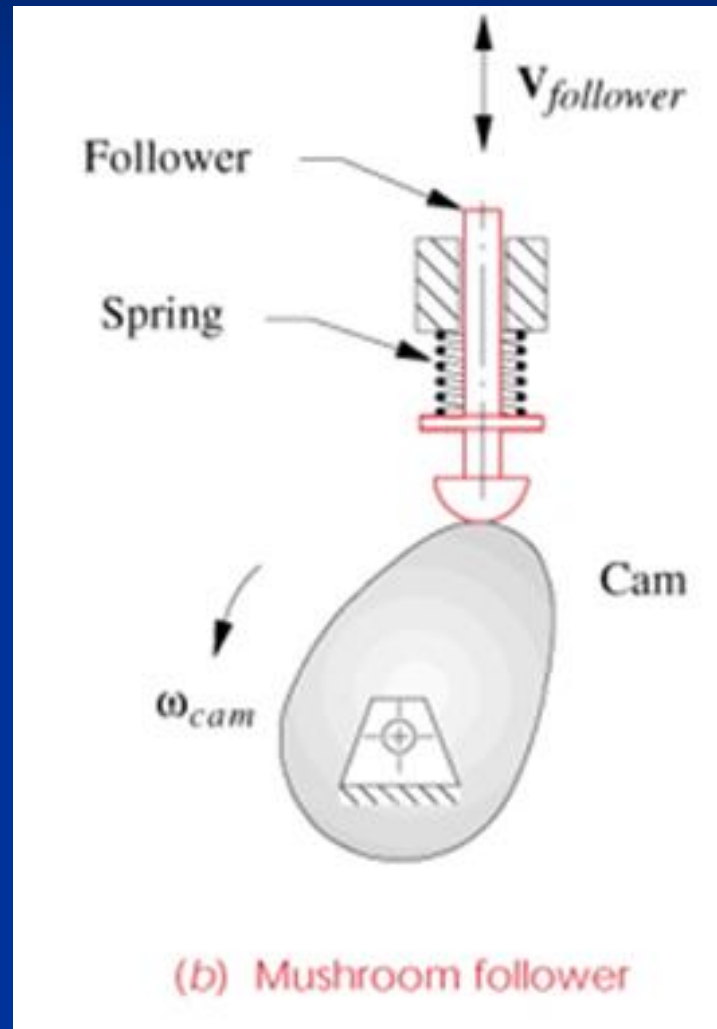
b) Roller follower



c) Flat faced follower



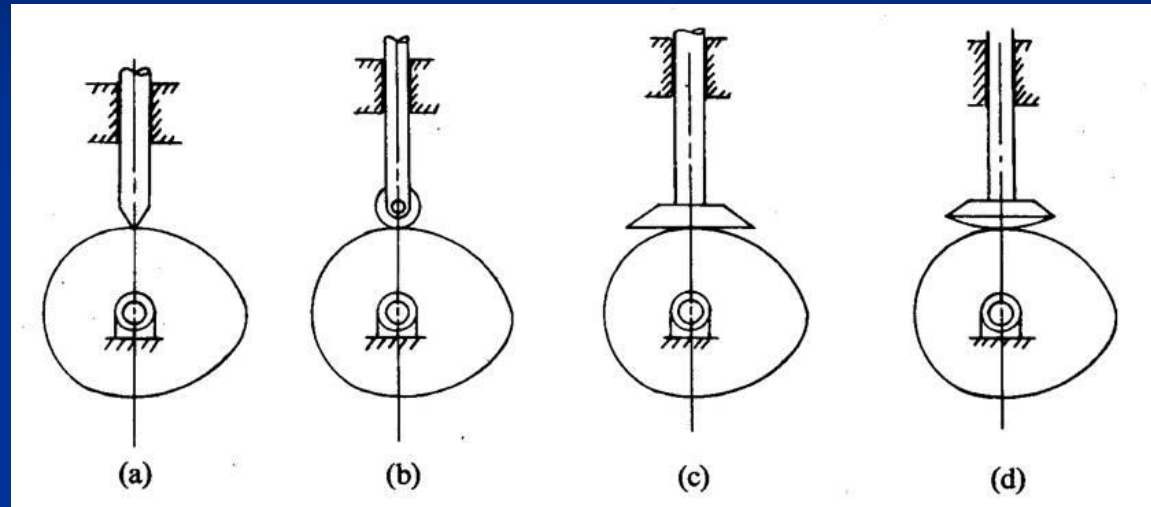
d) Spherical faced follower



2. According to the path of motion of follower

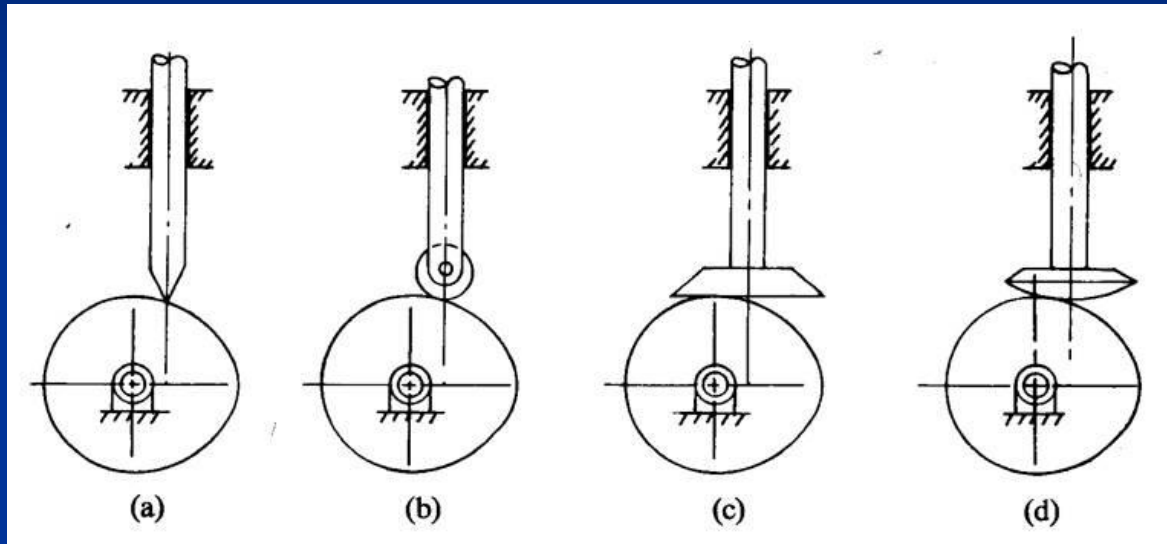
- a) Radial follower
- b) Offset follower

a) Radial follower



- When the motion of the follower is along an axis passing through the centre of the cam, it is known as radial followers. Above figures are examples of this type.

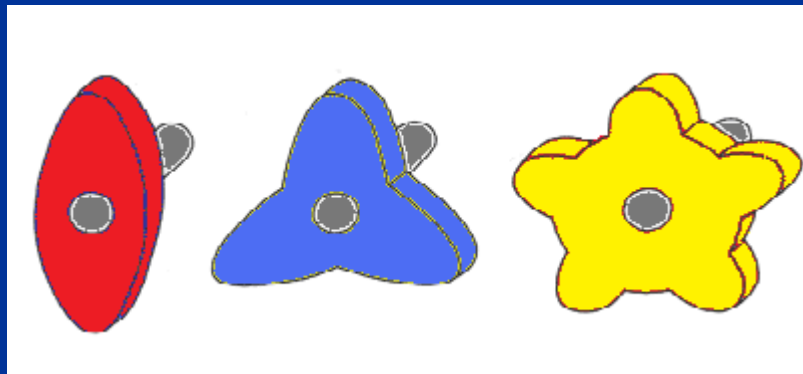
b) Offset follower



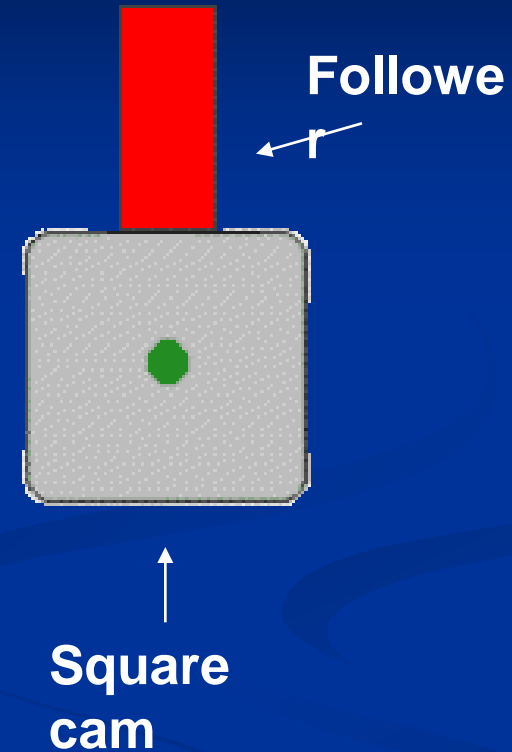
When the motion of the follower is along an axis away from the axis of the cam centre, it is called off-set follower. Above figures are examples of this type.

Cam and Follower

- *The 'bumps' on a cam are called lobes.*
- *The square cam illustrated has four lobes, and lifts the follower four times each revolution.*

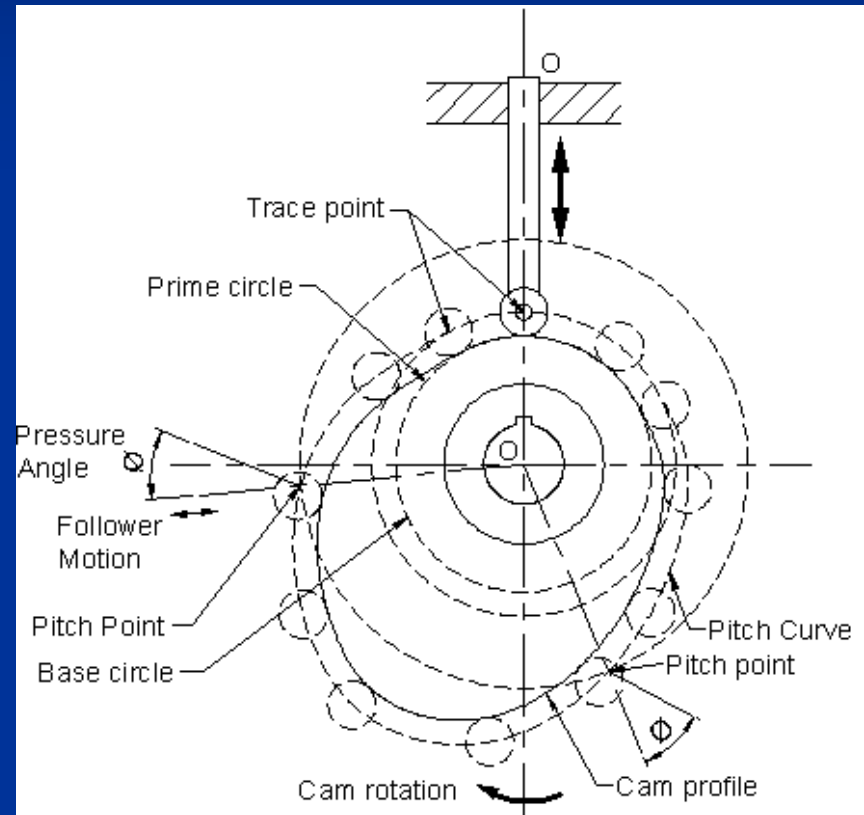


Examples of other rotary cam profiles.



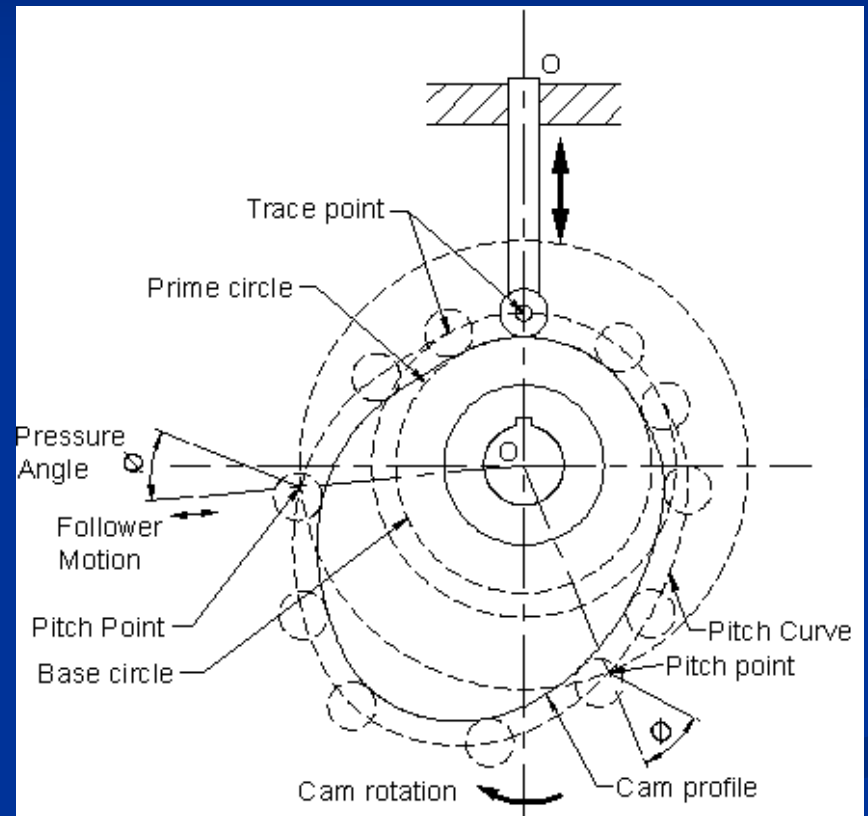
CAM Nomenclature

- **Cam profile:** The outer surface of the disc cam.
- **Base circle :** The circle with the shortest radius from the cam center to any part of the cam profile.
- **Trace point:** It is a reference point on the follower, and its motion describes the movement of the follower. It is used to generate the pitch curve.



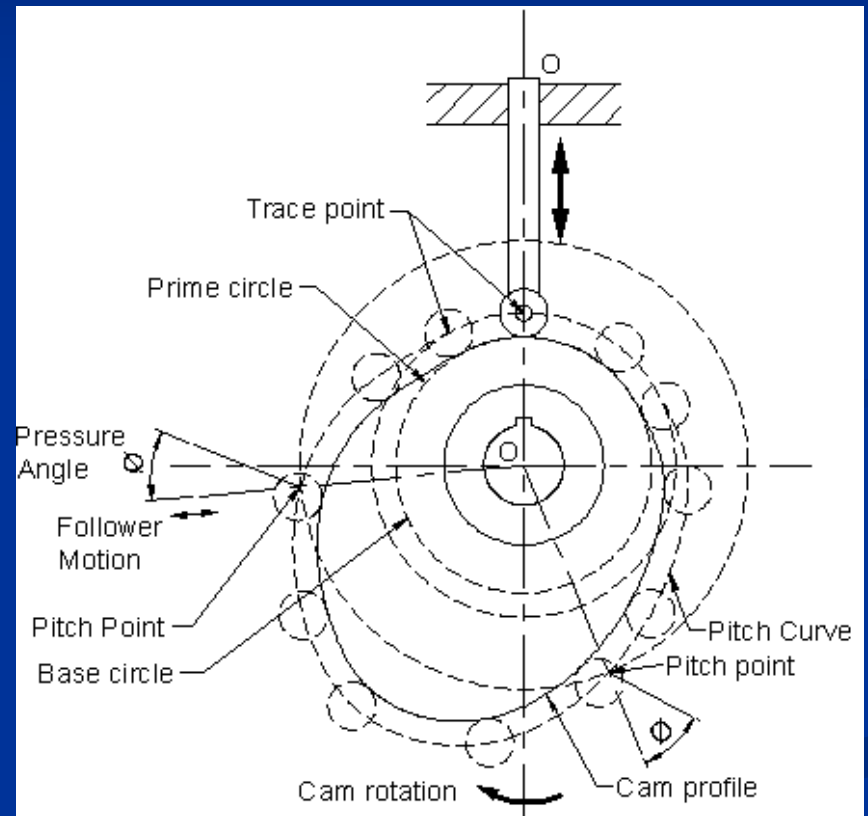
2. CAM Nomenclature

- **Pitch curve** : The path generated by the trace point as the follower is rotated about a stationary cam.
- **Prime circle**: The smallest circle from the cam center through the pitch curve



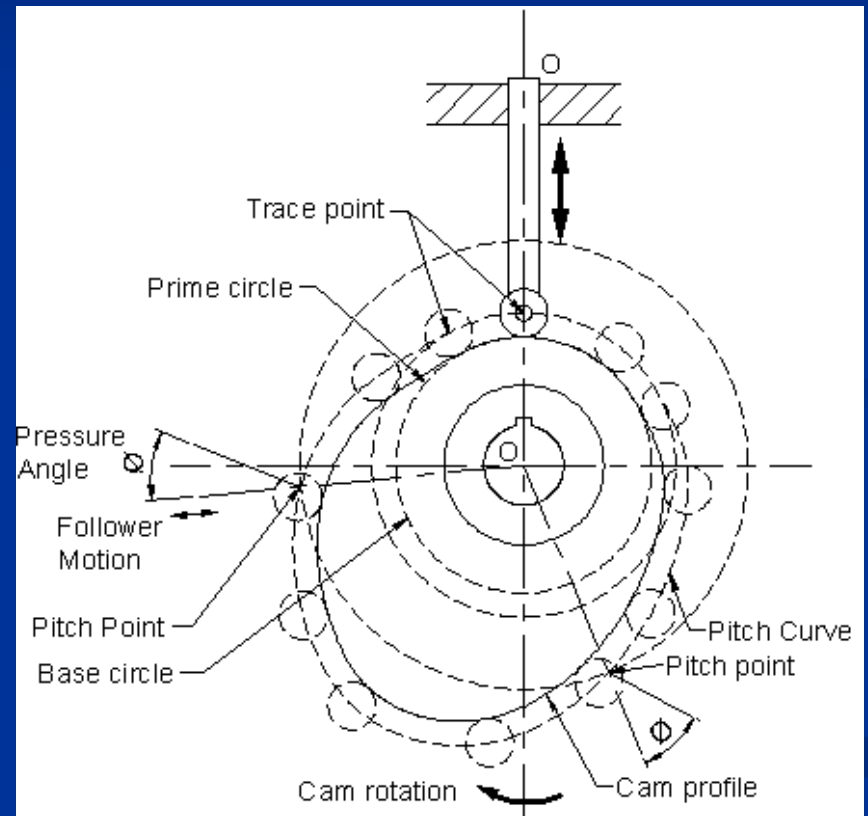
2. CAM Nomenclature

- **Pressure angle:** The angle between the direction of the follower movement and the normal to the pitch curve.
- **Pitch point:** Pitch point corresponds to the point of maximum pressure angle.



2. CAM Nomenclature

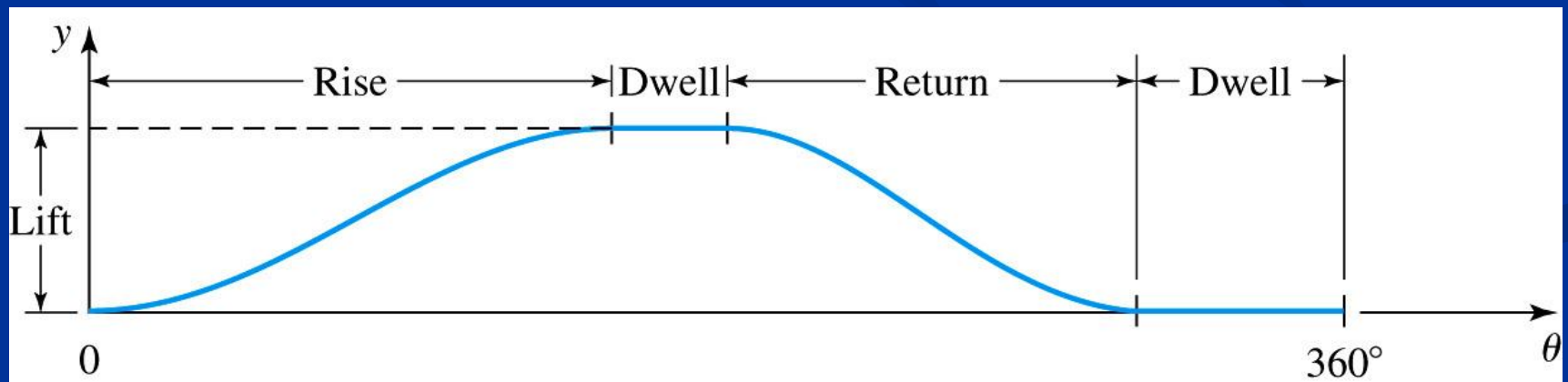
- **Pitch circle:** A circle drawn from the cam center and passes through the pitch point is called Pitch circle
- **Stroke(Lift):** The greatest distance or angle through which the follower moves or rotates



3. Motion of the follower

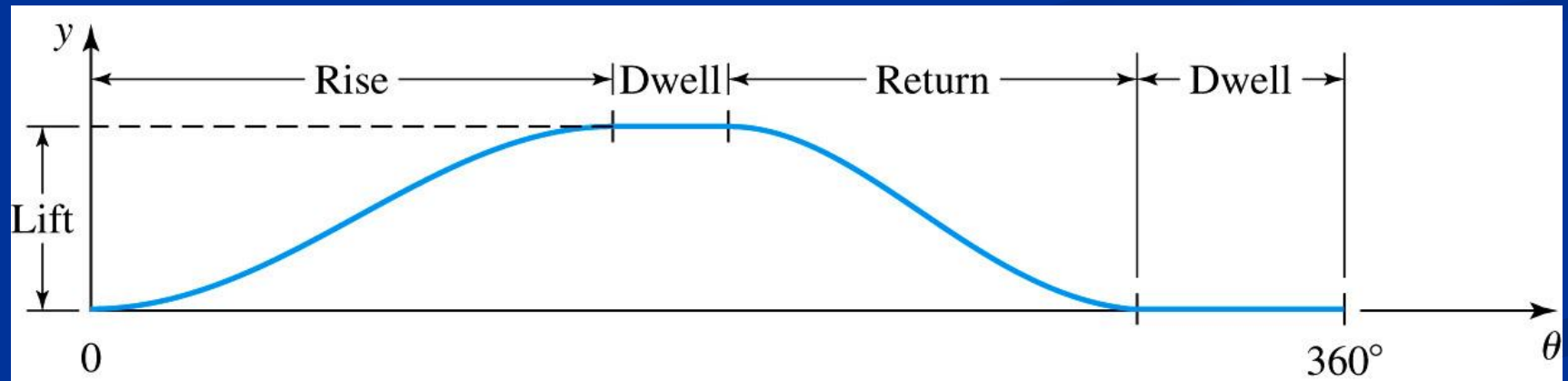
As the cam rotates the follower moves upward and downward.

- The upward movement of follower is called **rise (Outstroke)**
- The downward movement is called **fall (Return stroke)**.
- When the follower is not moving upward and downward even when the cam rotates, it is called **dwell**.



Displacement diagram:

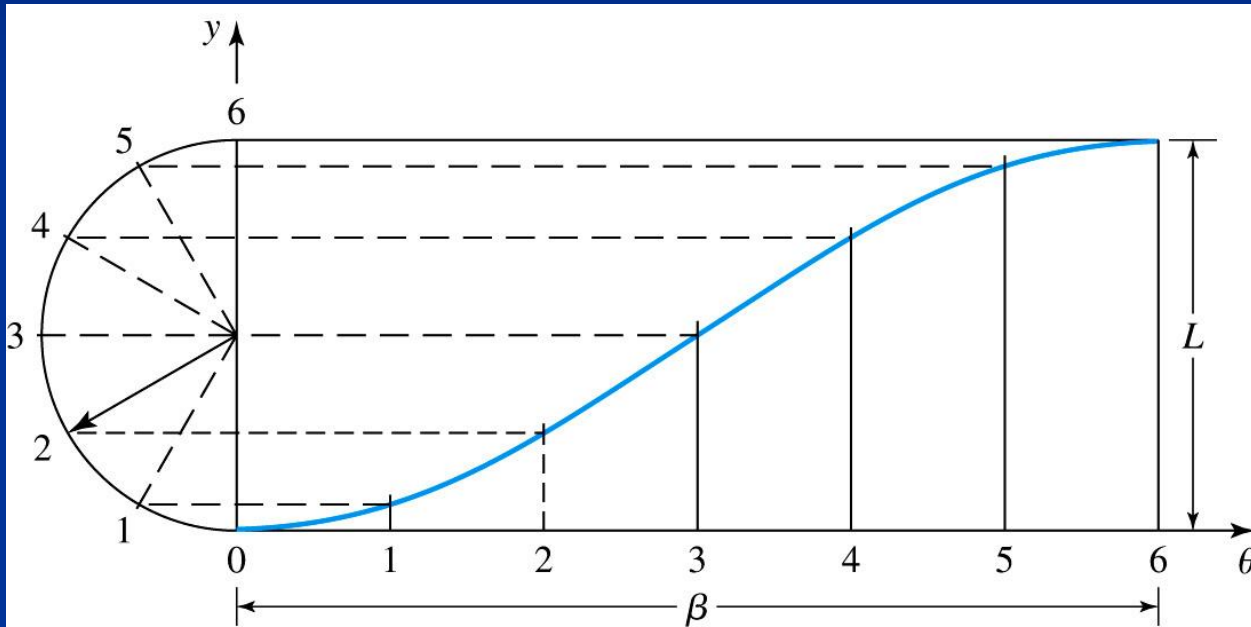
- Displacement is the distance that a follower moves during one complete revolution (or cycle) of the cam while the follower is in contact with the cam.
- It is the plot of linear displacement (s) of follower V/S angular displacement (θ) of the cam for one full rotation of the cam.



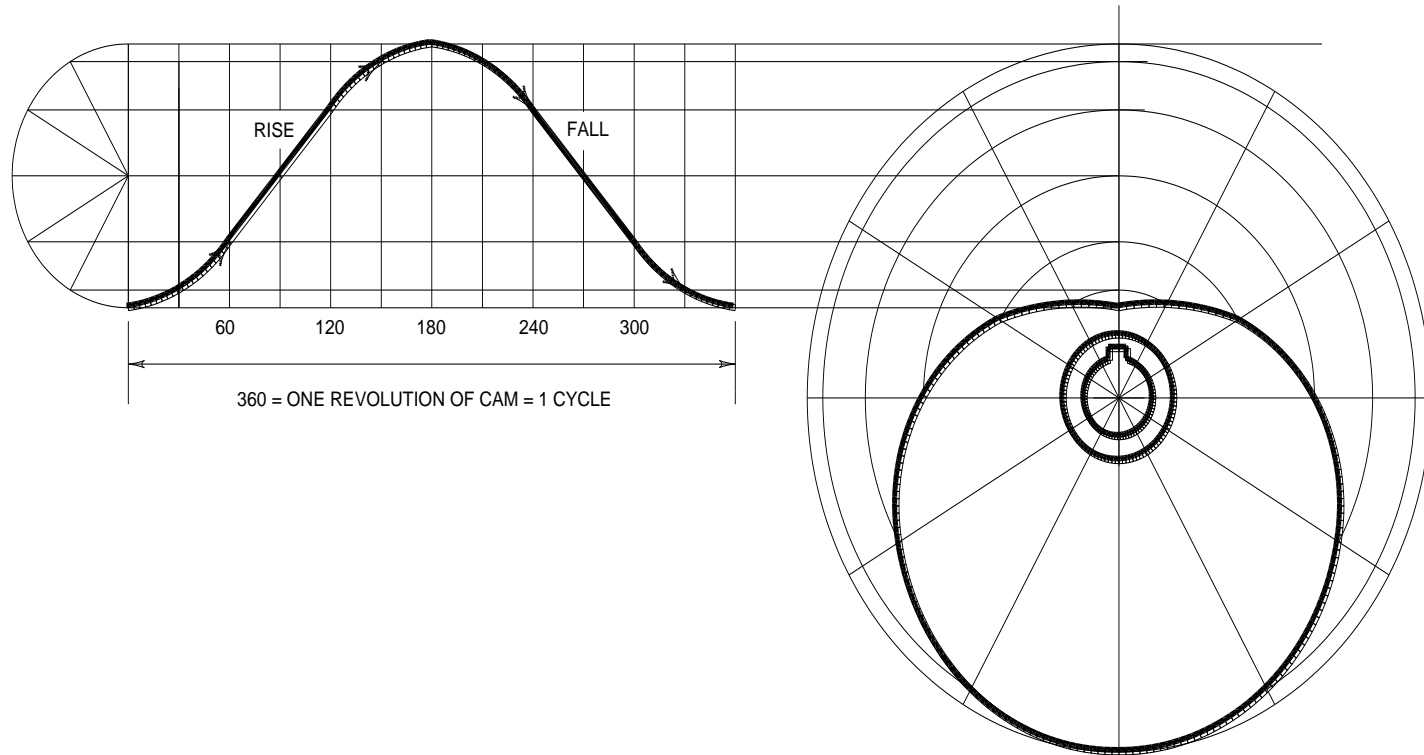
Types of follower motion

1. Simple harmonic motion
2. Uniform motion (constant velocity)
3. Uniform acceleration and retardation motion (parabolic motion)
4. Cycloidal motion

a) Simple harmonic motion

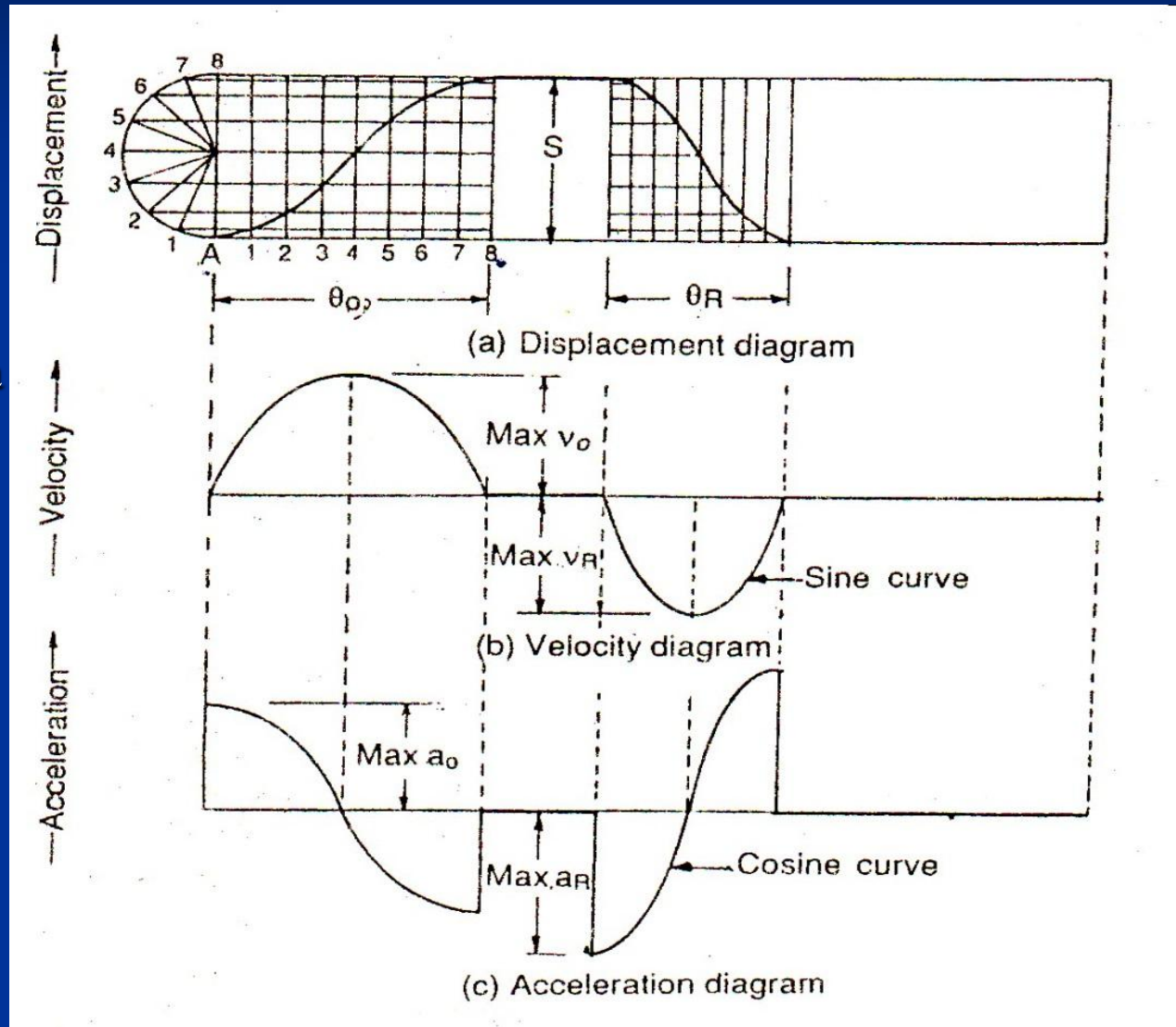


a) Simple Harmonic motion

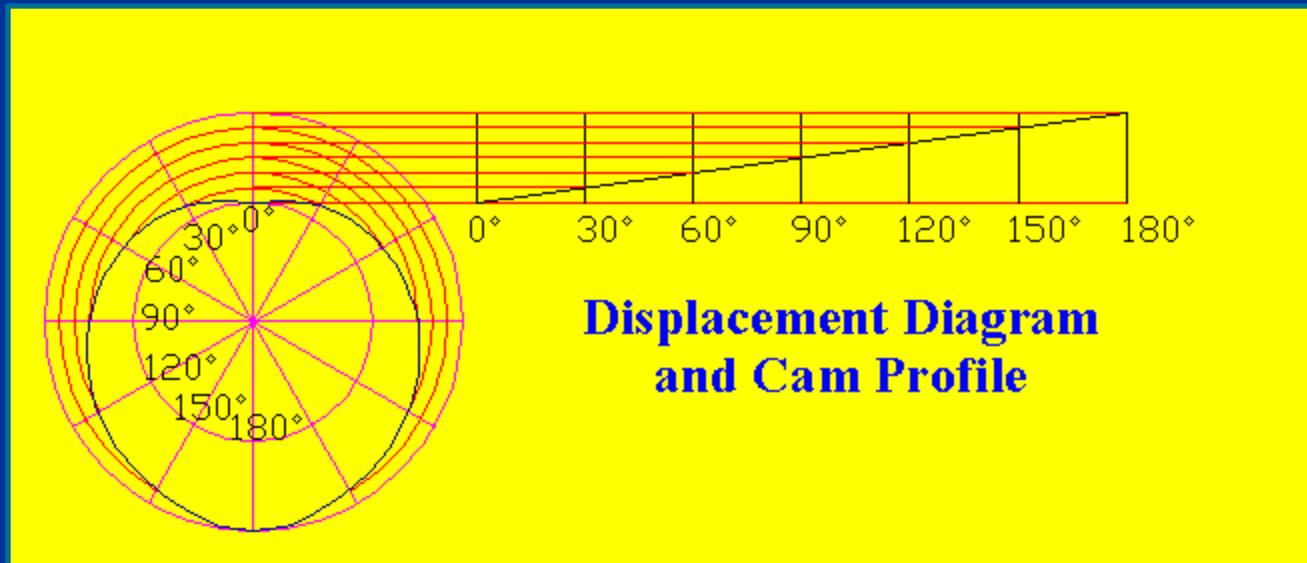


b) Simple harmonic motion

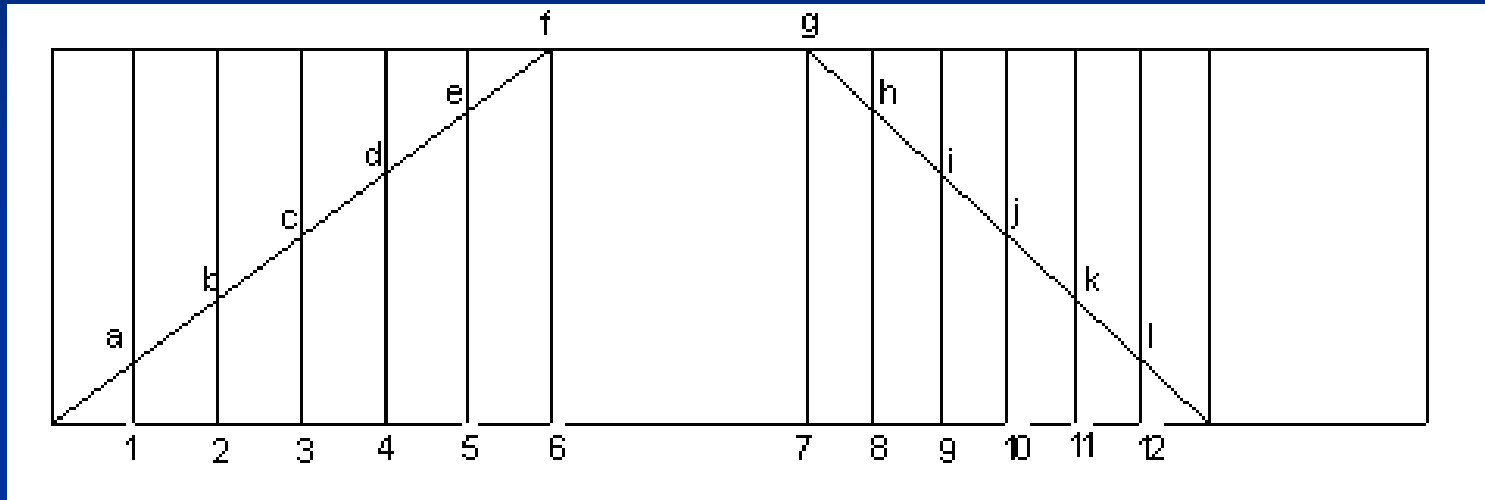
- Since the follower moves with a simple harmonic motion, therefore velocity diagram consists of a sine curve and the acceleration diagram consists of a cosine curve.



a) Uniform motion (constant velocity)



a) Uniform motion (constant velocity)

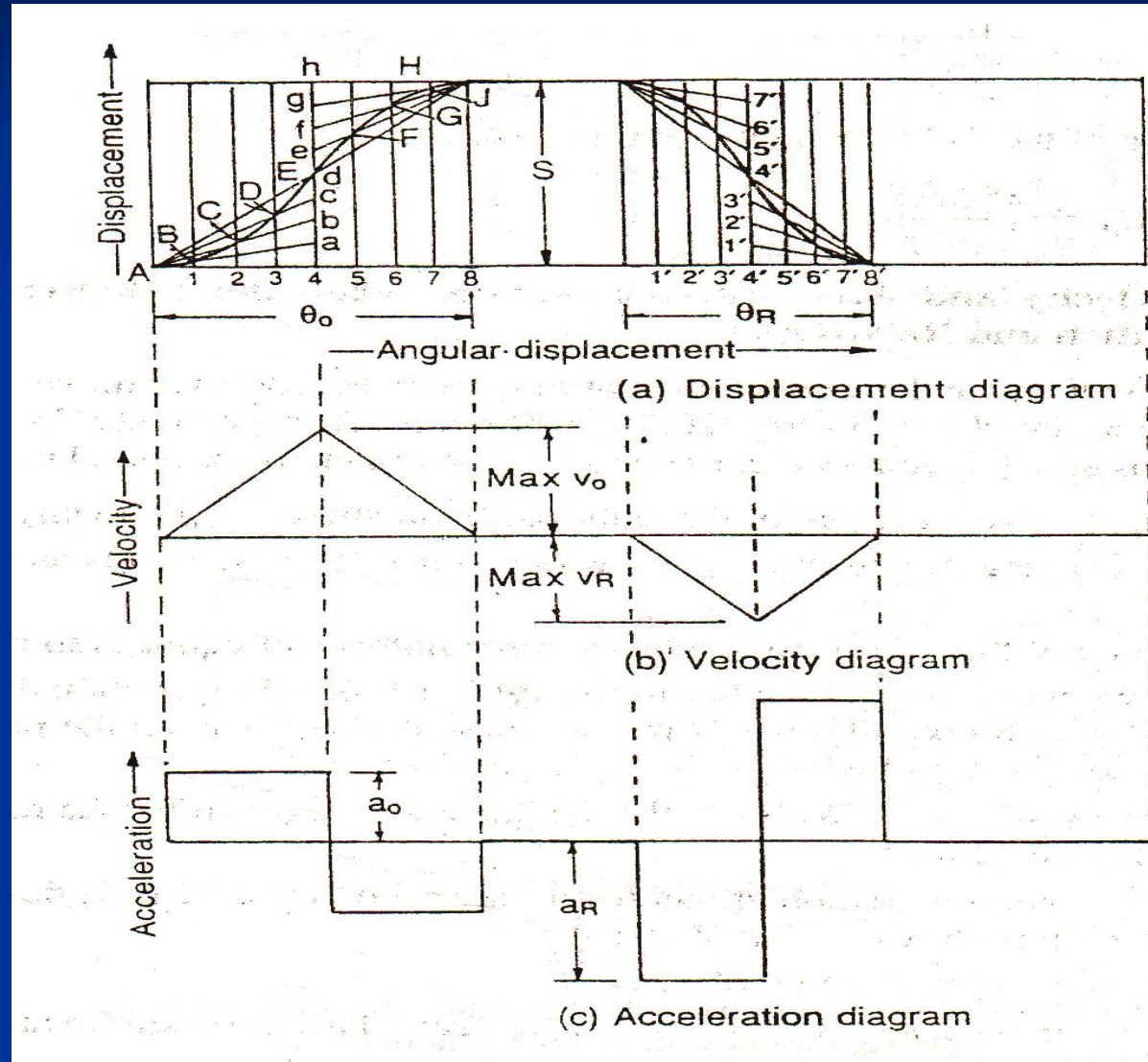


Displacement diagram

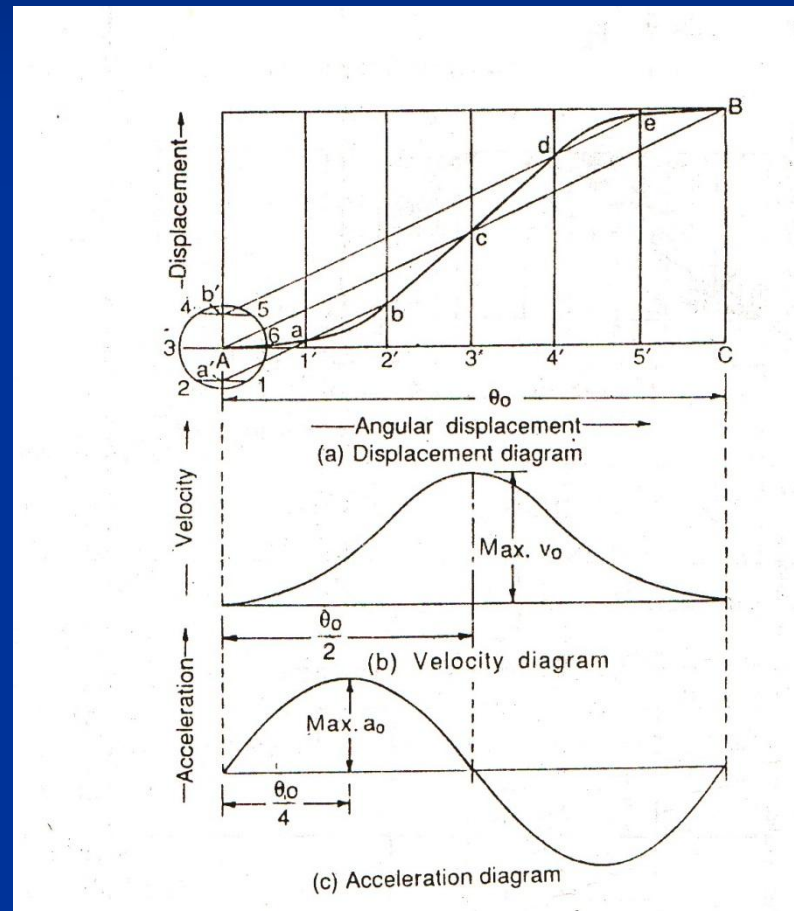
Since the follower moves with uniform velocity during its rise and fall, the slope of the displacement curve must be constant as shown in fig

c) Uniform acceleration and retardation

- Since the acceleration and retardation are uniform, therefore the velocity varies directly with time.



d) Cycloidal motion



CAM Profile

