Most cams are used to convert rotary motion into reciprocating motion. Some convert linear motion into reciprocating motion and a few convert rotary motion into oscillating motion or reciprocating. This output motion is achieved through the use of a follower.

As the cam turns, driven by the circular motion, the cam follower traces the surface of the cam transmitting its motion to the required mechanism. The motion created can be simple and regular or complex and irregular.

Followers are available in a range of designs to suit different needs but they can only do three things while being operated by a cam:

1. **Rise** (move up)
2. **Fall** (move down)
3. **Dwell** (remain stationary)

**Important Note – Categories of Cams**

Cams are identified by understanding the position of the axis of input motion of the cam compared to the output motion of the follower. Two types of motion are commonly used to categorise cams:

1. Input motion axis perpendicular to the output motion of the follower
2. Input motion axis parallel to the output motion of the follower

**Cams with Input Motion Axis Perpendicular to the Output Motion of the Follower**

One type of cam called a Disc Cam which has an external profile on a disc and either rotates or moves in a linear motion to move the follower. The axis of input movement by the cam is PERPENDICULAR to the output motion of the follower.

*Examples of Cams with Axis of Motion Perpendicular to Each Other*

Disc/Radial Cam (pear shaped)  Linear Cam (Wedge shaped)  Axis of input motion Perpendicular to movement of the follower
Cams with Input Motion Axis Perpendicular to the Output Motion of the Follower

Other types of cam are called End Cams and Cylindrical Cams. These cams either move the follower by having a groove in the profile of a cylindrical body for the follower to follow or a cylindrical profile on the end of a shaft in contact with the follower. The diagram below shows how the axis of input motion (rotation), indicated by the dotted line is parallel to the movement of the follower, indicated by the arrows.

Cylindrical Cam and follower  End Cam with follower  Axis of input motion parallel to output motion of follower

Cams with Input Motion Axis Perpendicular to the Output Motion of the Follower – Disc Cams

Now we know the categories of Cams we need to know about the motion of the follower relating to different disc cam profiles.

Profiles of cams:
1. **Pear shape** (Rotary)
2. **Eccentric Shape** (Rotary)
3. **Snail Shape** (Rotary)
4. **Linear Profile Cam** (Reciprocating)

**Pear Shape Disc Cam**

This type of cam is often used to open valves on an engine. The follower remains motionless (dwell) for about half of the rotation (cycle) of the cam and during the second half it rises and falls. This cam can be rotated both clockwise and anti-clockwise.

Pear Shape Disc Cam  Pear Shape Cams Operating Valves in an Internal Combustion Engine
**Eccentric Shape Disc Cam**

An eccentric cam produces a smooth motion continuous movement. The lift of the follower is equal to the distance the centre of rotation is from the centre of the cam. This cam can be rotated both clockwise and anti-clockwise.

![Eccentric Shaped Disc Cam](image)

**Snail Shaped Disc Cam**

When rotating for one complete revolution the follower stays level for approximately the first 120 degrees of rotation. The follower then rises slowly and then suddenly drops when it reaches and passes the peak. This cam cannot be rotated in both directions as the cam and follower would jam.

![Snail Shaped Disc Cam](image)

**Linear Profile Cam**

Unlike rotary cams, the linear cam moves backwards and forwards in a reciprocating motion and the shape of the surface of the cam determines how far the follower moves.

![Linear Profile Cam](image)
Cams with Input Motion Axis Parallel to the Output Motion of the Follower – Cylindrical and End Cams

Now we know the categories of Cams we need to know about the motion of the follower relating to different End and Cylindrical type cams

Profiles of cams:
1. End Cam – Box Cam
2. Cylindrical Cam – Barrel Cam

End Cam – Box Cam
As the disc mounted on the end of the shaft rotates the follower follows the path of the groove cut into its face. Cams of this type are used in a range of machines where a repetitive motion is needed.

Cylindrical Cams - Barrel Cam
As the cylinder rotates the follower follows the path of the groove cut around the surface of the cylinder.
**Common Types of followers**

Cams followers can be either reciprocating or pivoting. There are various methods of transferring the motion from the cam to the follower including the following:

1. **Knife Edge**
2. **Flat-face**
3. **Roller**
4. **Curved-shoe /spherical**

The cam follower can be either offset (as shown below) or in line with the cam centre of rotation.

- **Knife Edge Follower**
  This follower can follow complicated profiles, allow the cam to rotate in both directions but unfortunately does wear quickly due to the low surface contact (sharp point in contact with cam).

- **Flat-face Follower**
  Long lasting due to large surface area but can only work with simple profiles (won’t work with concave shapes)

- **Roller Follower**
  This follower has very low frictional losses, is very reliable and long lasting due to the use of a roller bearing. If a large roller bearing is used, the follower will only work on simple profiles unlike the knife edge follower.

- **Curved-shoe /spherical Follower**
  This follower provides a good balance between knife edge and flat face followers, reducing issues of wear by enabling low cost replacement of the shoe.
Questions

a. What is the input motion and output motion of the following Cam and follower?

1. Input Rotary and output Oscillating
2. Input Linear and output Rotary
3. Input Oscillating and output Rotary
4. Input Rotary and output Reciprocating

b. What type of Cam is pictured in question a?
   1. End Cam
   2. Disc Cam
   3. Pear Shaped Cam
   4. Barrel Cam

c. Look at the Cam in question a, Is the axis of rotation perpendicular or parallel to the output motion?
   1. Perpendicular
   2. Parallel

d. What type of follower would be ideal to follow the profile of the irregular disc cam shown below?

   1. Roller Follower
   2. Knife Follower
   3. Flat follower
   4. Curved Shoe follower
e. What type of output motion would a follower display from a snail cam?
   1. Continuous reciprocating motion
   2. No movement for about 120° then a slow rise followed by a slow fall.
   3. A slow and progressive rise followed by a sudden fall
   4. No movement for 90° then a slow rise and slow fall

f. What type of Cam moves a follower so it displays continuous reciprocating motion.
   1. Cylindrical Cam - Barrel
   2. Disc Cam – Eccentric
   3. Disc Cam – Pear
   4. End Cam - Box

g. List 3 things a follower can do while being in contact with a cam.
   1. __________________________________________________________
   2. __________________________________________________________
   3. __________________________________________________________

h. What type of motion is commonly used to categorise disc cams.
   1. Input motion axis perpendicular to the output motion of the follower
   2. Input motion axis coincident to the output motion of the follower
   3. Input motion axis parallel to the output motion of the follower
   4. Input motion axis tangent to the output motion of the follower

i. What type of motion is commonly used to categorise cylindrical cams.
   1. Input motion axis perpendicular to the output motion of the follower
   2. Input motion axis coincident to the output motion of the follower
   3. Input motion axis parallel to the output motion of the follower
   4. Input motion axis tangent to the output motion of the follower

J. What type of cam is used in the following machine?

   1. Pear Shaped Cam
   2. Box Cam
   3. Eccentric Cam
   4. Linear Cam
   5. No cam mechanism