Cams

Cams are irregularly shaped machine members which impart motion to a driven link called a **follower.**

Cams are important because they provide the simplest means of achieving almost any desired follower motion.

Cams are found in printing presses, machine tools, internal combustion engines, mechanical calculators.

The shape of a cam dictates the behavior, or motion, of the follower. A **displacement diagram** is used to graphically indicate how the follower behaves as a function of time.

We will assume that the angular velocity of a cam is constant.

In a displacement diagram, degrees of cam rotation are plotted on the horizontal axis and the displacement of the follower is plotted on the vertical axis.

By examining the derivatives of the displacement diagram, we can determine velocities, accelerations, and jerks of the cam. **Jerk is a measure of the time rate of change of the inertia force**. Infinite jerk causes vibrations in the follower system and affects the life of the cam.

Common types of follower motions are:

Constant acceleration
Modified Velocity
Simple Harmonic
Cycloidal

Constant Acceleration

$$s = \frac{1}{2} A t^2$$

In terms of cam parameters, it is often preferable for the engineer to express time in terms of cam rotation, instead of time. Since we are assuming a constant angular velocity of the cam

$$t = \frac{q}{w}$$

$$q = cam\ rotation$$

$$w = angualr\ velocity$$

$$s = \frac{1}{2} A \left(\frac{q}{w} \right)^2$$

Let the follower rise to a displacement of h units in an interval.
Let β be the total rotation in an interval.

Halfway through the interval , $\theta = \beta/2$

$$\frac{h}{2} = \frac{1}{2} A\left(\frac{b^2}{4w^2}\right)$$

$$A = \frac{4hw^2}{b^2}$$

Velocity = At = $\frac{4hw^2}{b^2}\left(\frac{q}{w}\right) = \frac{4hwq}{b^2}$

Displacement = $s = 2h\frac{q^2}{b^2}$

$$s = h\left[1 - 2\left(1 - \frac{q}{b}\right)^2\right]$$

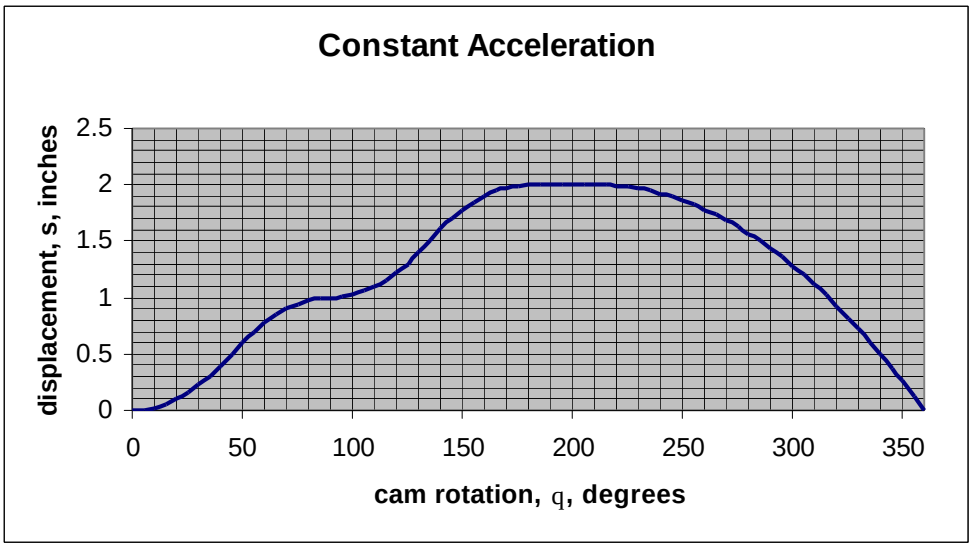
When $\theta \geq .5\,\beta$ then $V = \frac{4hw}{b}\left(1 - \frac{q}{b}\right)$

$$A = -\frac{4hw^2}{b^2}$$

Example:

A follower is to rise 1.0 inch with constant acceleration during 90° of cam rotation and then is to rise an additional 1.0 inch with constant deceleration for the next 90°. From 180° to 210° the follower is to dwell and then from 210 to 360° the follower is to fall with constant acceleration followed by constant deceleration

q	b	**s**
0–90 °	π/2	1
90 - 180°	π/2	2
180 - 210°	π/6	2
210 - 360°	5* π/8	0


Constant Acceleration
displacement, s, inches
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
300
350
cam rotation, q, degrees