Analytical Profile Design for an in-line, translating roller follower, cam.

The pressure angle for an in-line, translating roller-follower cam is given by the following formula:

$$d = \tan^{-1}\left[\left(\frac{S'}{W}\right)\left(\frac{r_f + r_b + S}{(r_f + r_b + S)^2}\right)\right]$$

r_f = radius of roller
r_b = base circle radius
s = trace point displacement
W = cam's angular velocity
s" = velocity of trace point

The x and y co-ordinates of the cam profile are given by:

Rx = -[r_f + r_b + s]sin(θ) + $r_f$sin($\theta - \delta$)
Ry = [r_f + r_b + s]cos(θ) - $r_f$cos($\theta - \delta$)

Draw the cam profile and find the minimum radius of curvature for the given cam schedule.

Stage 1: Follower rises 1.5 inches I 1.5 sec using SHM.
Stage 2: Follower dwells for 2.0 sec.
Stage 3: Follower returns in 1.5 sec using cycloidal motion
Stage 4: Follower dwells for 2.0 sec

The roller radius is 0.5 inches.
The base circle of the cam has a radius of 3.5 inches.

Step 1:

Compute angular velocity of cam

Total time = 1.5 + 2.0 + 1.5 + 2.0 = 7.0 sec.

Step 2:

Determine analytical expressions for displacements, velocities and accelerations

$\beta_1 = \omega \Delta t_1$ = (0.143 rev/s)*(1.5 s) = 0.214 rev = 77.2°
$\beta_2 = \omega \Delta t_2$ = (0.143 rev/s)*(2.0 s) = 0.286 rev = 102.8°
$\beta_3 = \omega \Delta t_3$ = (0.143 rev/s)*(1.5 s) = 0.214 rev = 77.2°
$\beta_4 = \omega \Delta t_4$ = (0.143 rev/s)*(1.5 s) = 0.286 rev = 102.8°

ω = .143 rev/s	Motion	h	S_o	β	θ_0	s	s'	s"
1	SHM	1.5	0	77.2°	0	$\frac{1}{2}h\left(1-\cos\left(\frac{pq}{b}\right)\right)$	$\frac{wph}{2b}\left(\sin\left(\frac{pq}{b}\right)\right)$	$\frac{pw^2h}{2b^2}\cos\left(\frac{pq}{b}\right)$
2	Dwell	0	1.5	102.8°	77.2°	s = 1.5	s' = 0	s" = 0
3	Cycloidal	-1.5	1.5	77.2°	180.0°	$s_o + h\left[\frac{q-q_o}{b} - \frac{1}{2p}\sin\left(\frac{2p(q-q_o)}{b}\right)\right]$	$\frac{hw}{b}\left[1-\cos\left(\frac{2p(q-q_o)}{b}\right)\right]$	$\frac{2phw^2}{b^2}\left[\sin\left(\frac{2p(q-q_o)}{b}\right)\right.$
4	Dwell	0	0	102.8°	257.2°	s = 0.0	s' = 0	s" = 0