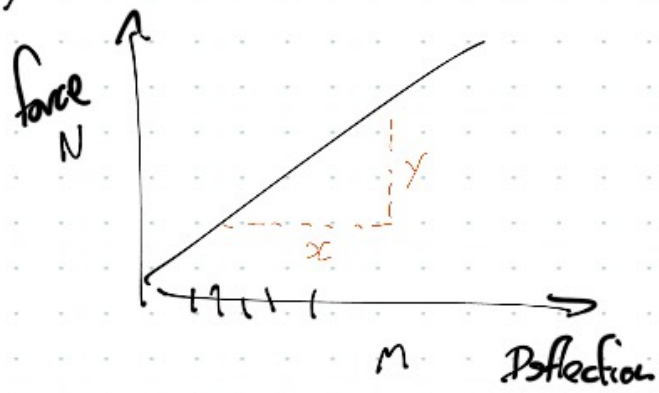
Week 7

Valvetrain Dynamics.

The spring force?



K = Spring Rate. N/mm (Y/x)

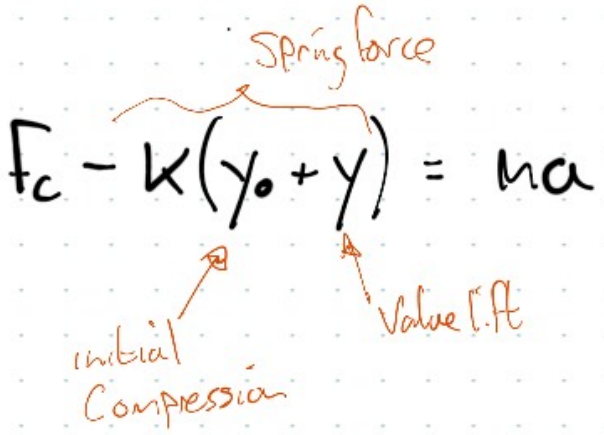
F_c = force M = moving mass

M = Valve, follower, collets, retainers, ½ Spring (linear)

From Newtons laws F = ma

F_c − Spring force = M.a

So



$$F_c = ma + k(y_0 + y)$$

At full lift, acceleration is negative

At high RPM, acceleration at full lift is negative and can be big enough that ma is equal and opposite to the spring force so $F_c = 0$

This is the 'Float Speed' of the valve (in RPM)

lets look at some calculations ....

Number of Cam degrees / second.

$$= \frac{RPM_{cam}}{60} \times 360 \quad ^\circ/sec$$

So the number of Cam degrees / second

$$= 6 \times RPM_{cam}$$

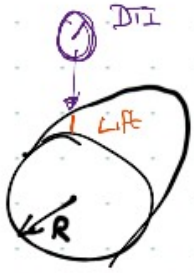
Valve velocity in mm/sec

$$= (\text{velocity in mm}/^\circ) \times 6\, RPM_{cam}$$

Valve acceleration in mm/sec^2

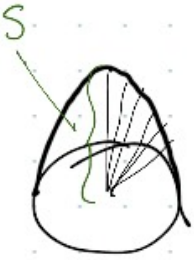
$$= (\text{Valve acceleration in mm}/^\circ/^\circ) \times (6\, RPM_{cam})^2$$

Measuring a Cam



Turn cam 1 degree at a time...

θ	Lift
1	
2	
3	



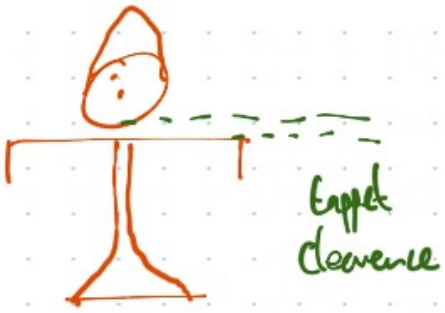
We use S to represent...

$$S = R + L$$

Base Circle — Lift

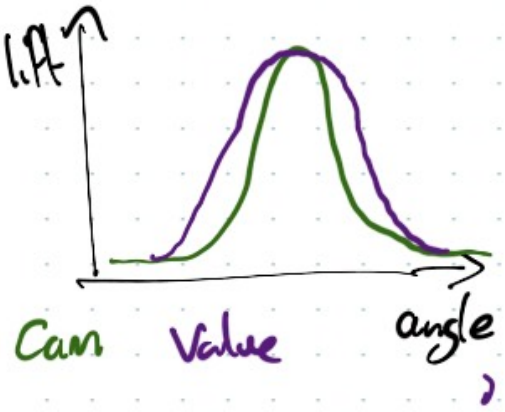
Remember:





Getting Valve lift - — impatant Points

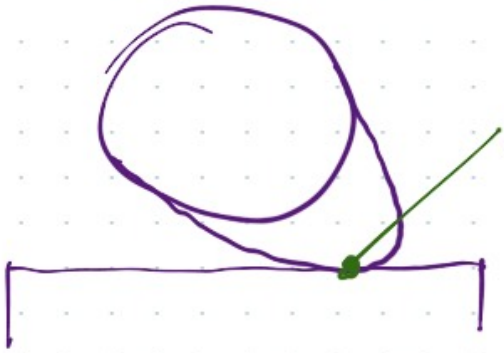
Can creates the valve lift



Shit graph ---

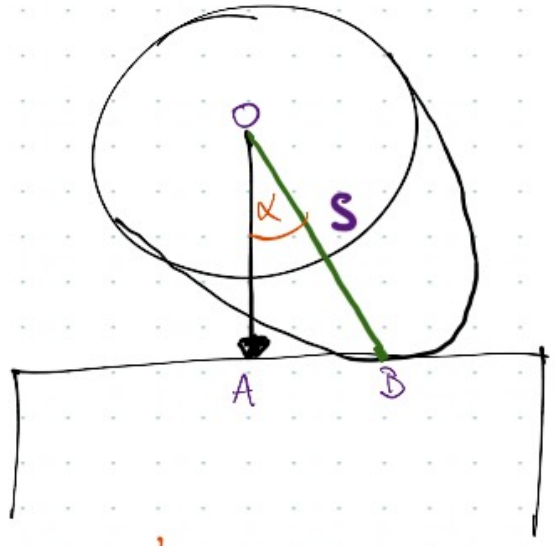
Impartant is the

Shape difference



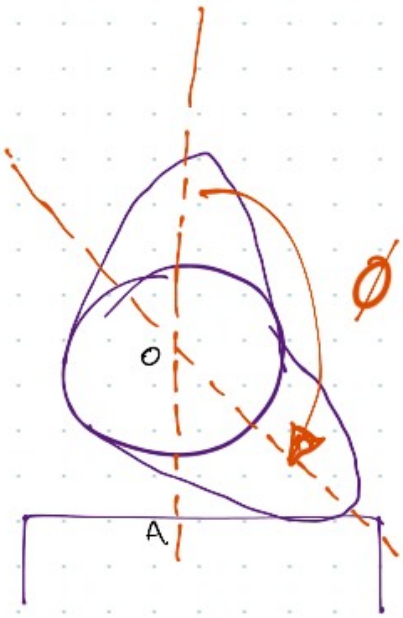
The contact point slides along the surface of the cam follower / Bucket.

Valve Dynamics



This touches when AO is the largest

$OB = S = (R+L)$



ϕ = Angle cam has turned from the vertical.

Question:
When cam has turned ϕ degrees, where is the contact point?

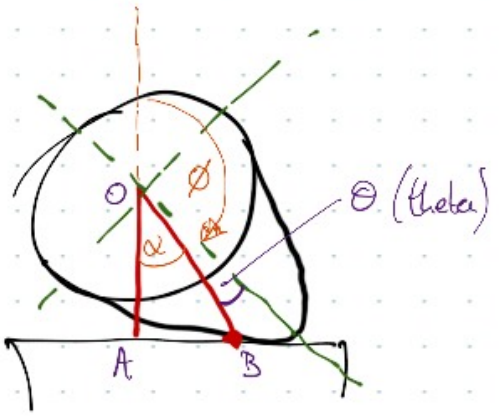
We can use $AO = S \cos \alpha$

Can we get α?

$$\alpha = 180 - (\theta + \phi)$$

Theta

Phi



Ø is the angle the nose has turned from the vertical (Can Rotation)

α = is the angle between contact point and OA (lift)

θ is the angle from the nose to the contact point

So $\alpha = 180 - (\theta + \phi)$

Example: Turn the cam (110°) from vertical

we need to know the contact point

from measurement we will know the relationship between θ and S

So

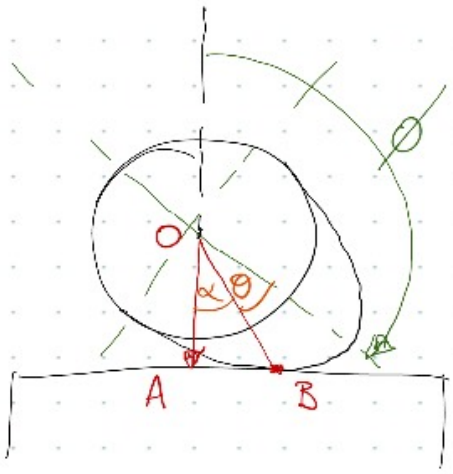
θ	S	$OA = S\cos(180-(\theta+110))$
0	S_0	
1	S_1	
2	S_2	
3	S_3	

for 110°

In the end we get ....

θ ↓ \ ϕ →	0	1	2	3	4	5	- - -	—
0								
1								
2								
3								
4								
5								

for every angle ϕ the cam turns from the vertical, we find the angle θ which makes $OA = S\cos(180-(\theta+\phi))$ A maximum . . .



Don't forget tappet clearance

Lift = OA − Tappet clearance − R

This will get you the lift for every angle ϕ of Cam Rotation