

Engine Design

So far we have looked at Combustion and Valve Train ... What else is important in the fundamental Engine Design?

Balance :

Primary ✓

Secondary ✓

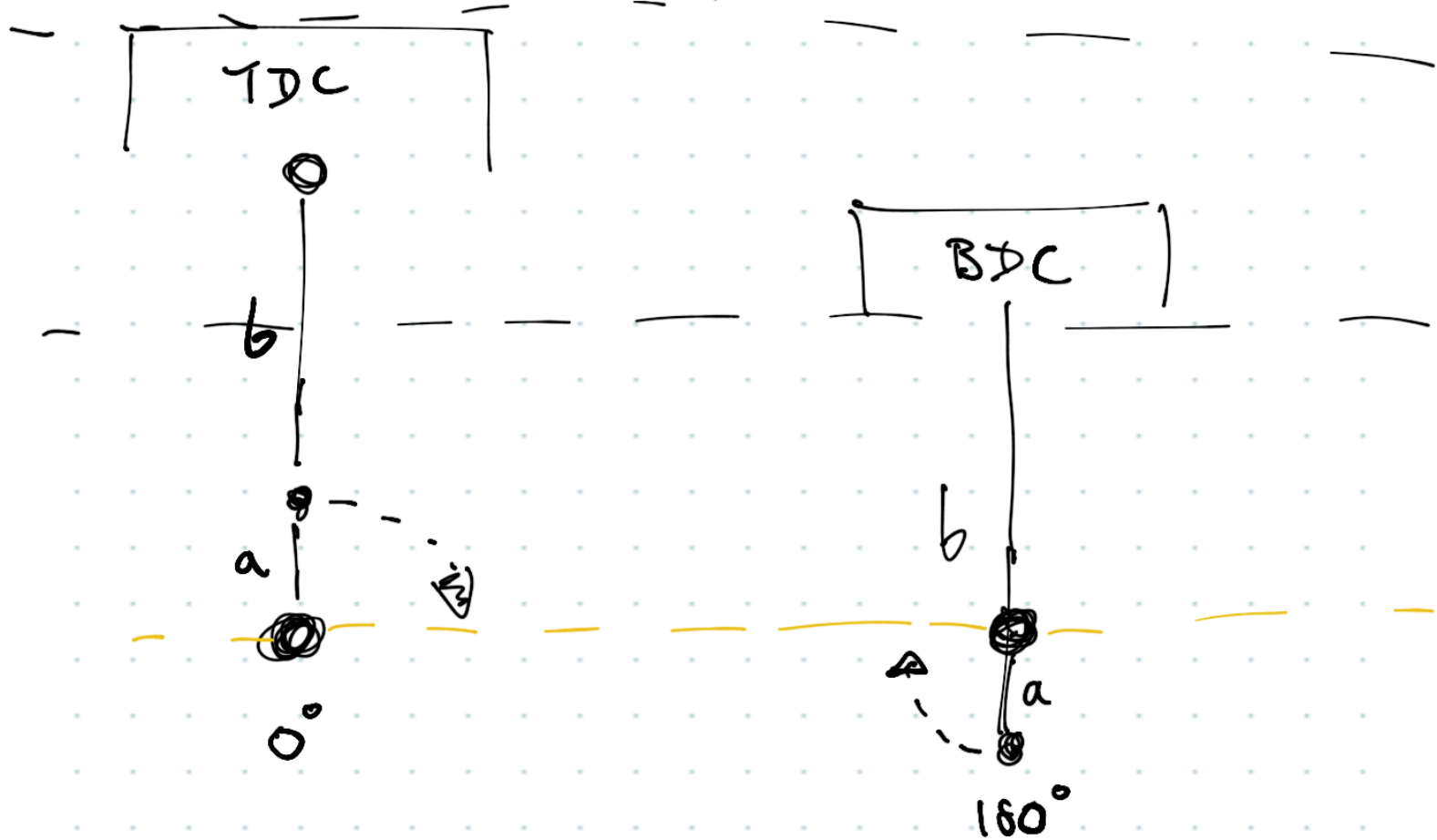
Firing Order

Big Bang Engines

App :

Trans 4 Motor

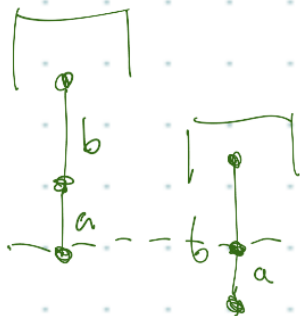
What is Secondary Balance



Where is the piston at 90° ?

It's NOT $\frac{1}{2}$ way down

So where the hell is it?



Note

Stroke = $2 \times$ Crank Radius

$$x^2 = b^2 + a^2$$

So the piston is at the position

$$(a+b) - \sqrt{b^2 - a^2}$$

So if we had a con rod length = 100 mm
Crank radius = 50 mm

$$b = 100 \quad a = 50$$

$$\text{Piston position} = (a+b) - \sqrt{b^2 - a^2}$$

So in the 2nd 90°

it moves? $100 - 63.39$
 $= 36.6 \text{ mm}$

$$= 150 - \sqrt{100^2 - 50^2}$$

$$= 63.39 \text{ mm}$$

So is an inline & balanced?

No

→ app

See app and Simulation

Firing orders :

So an inline 4 has 2up, 2down
Firing order 1,3,4,2

4 cylinder

Engine	Crank	Firing	Graphic	Example
I4	180°	180, 180, 180, 180	10101010	Most stuff
I4	90° Crossplane	180, 90, 180, 270	10110100	Yamaha M1
I4	180°	0, 180, 0, 540	20200000	ZX-RR (long Bang)
60° V4	180° with 60° Split pins	180, 180, 180, 180	10101010	Ford / Essex
65° V4	180°	180, 115, 180, 245	10110100	RSV4
70° V4		180, 110, 180, 250		V-max
90° V4		180, 90, 180, 270		VFR800

I'll add more