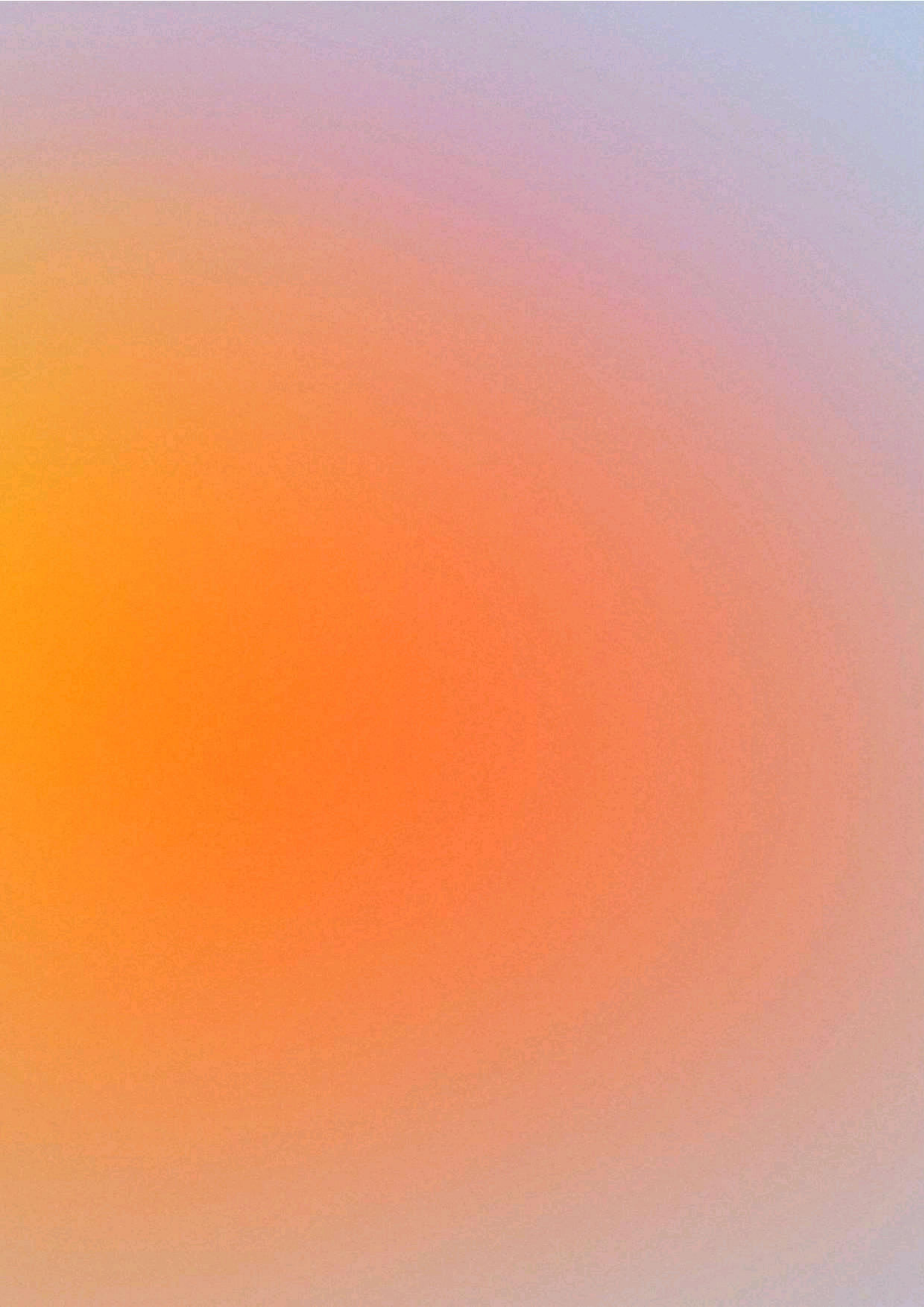


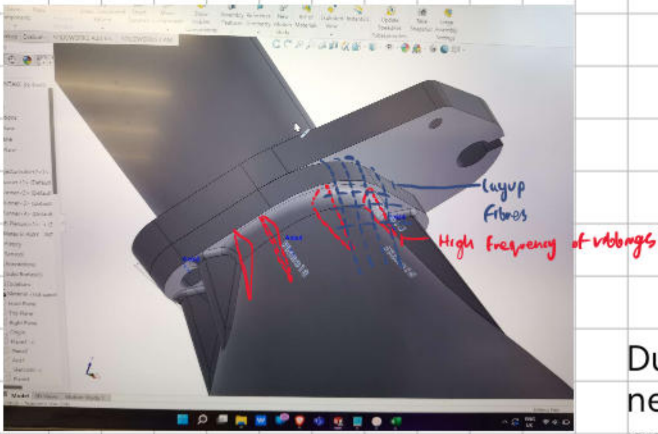
Intake Design Review 1 : 26/10/22

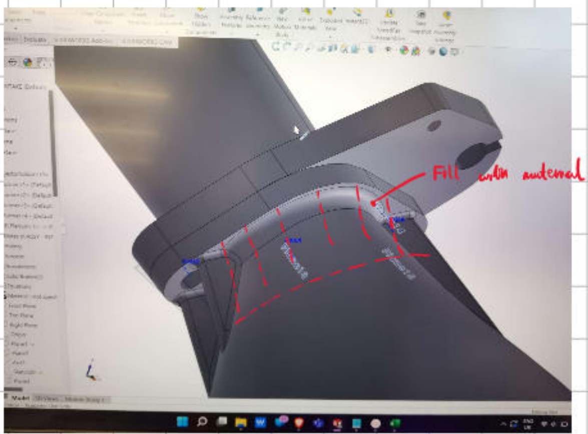
Arden-Mete-Tasen

Objectives:

- 1, 3, 4 are MUST
- 7 will be useful- write some code (saves lots of effort)
- 2 and 5 - lower priority, 'would be nice to have'

1

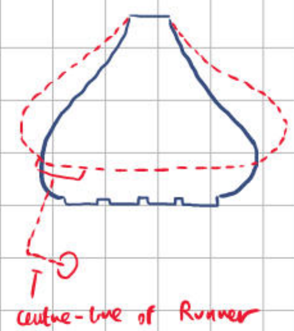


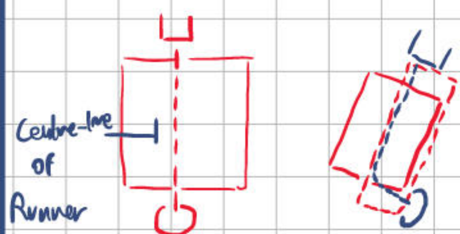



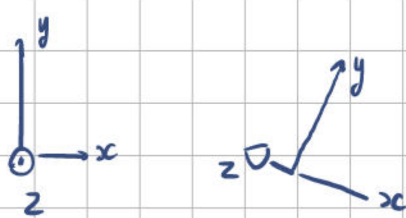

Due to bending monents at the neck of the plenum,and as3D prints are wear in shea orthogonal to the plan of print layers- we must lay that up.

The layup of glass or carbon fibre provides a'pre-tensed' load, which prevents fracture of the neck under bending.

2



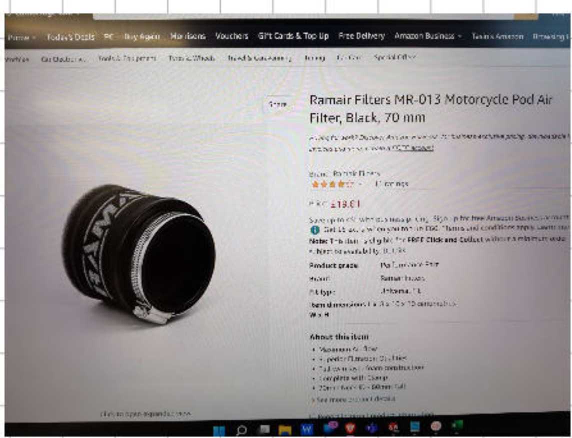

Plenum volume can also change, but must remain around the simulated optimum volume of 750mm. The curve also cannot be too sharp, othewise you will get boundary laye separation resultin in losses to the airflow going into the engine cylinders at the edges(1 and 4).

1 Rotation about z

2 Rotation about y

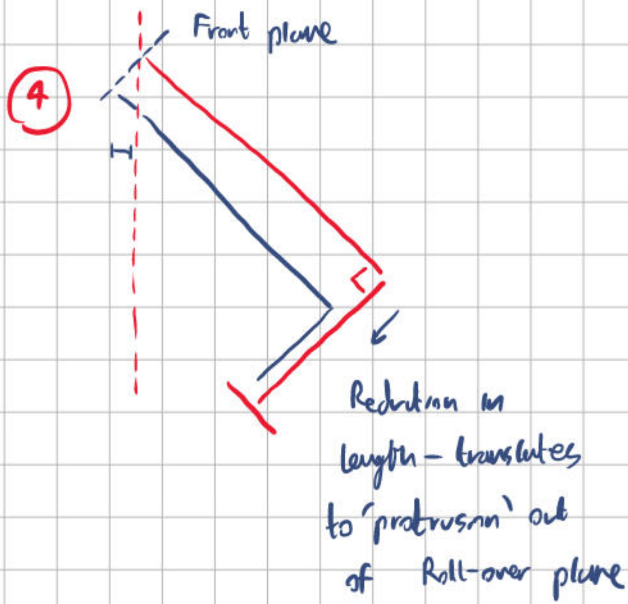
3 Requires small change in inlet 'hole' shell

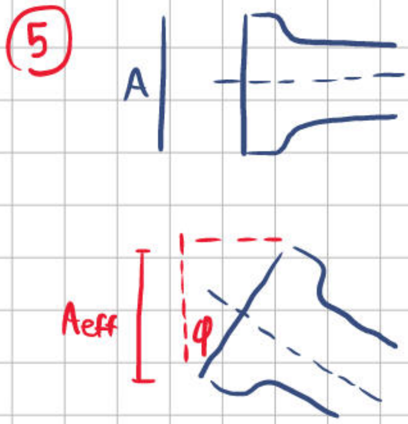
3




New air filter: ~80mm (± 20mm - not sure if product includes 'attachment' dimensions)

Current: ~150 mm




$$A_{eff.} = \cos(\varphi) A$$

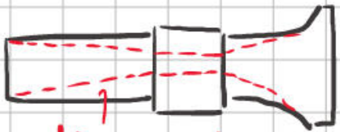
While 290mm is an upper bound for the runner length, this does includ the curved path length of the injecto holders as well. Overall then, the length limit is lower.

From the simulations, there i a greater drop-off at high end (high RPM) torque for longer lengths, so actually a shorte runner length is better.

Effective cross-sectional area facing in direct air flow is also an issue- try to keep this fixed, but avoid making the angle any further vertical.

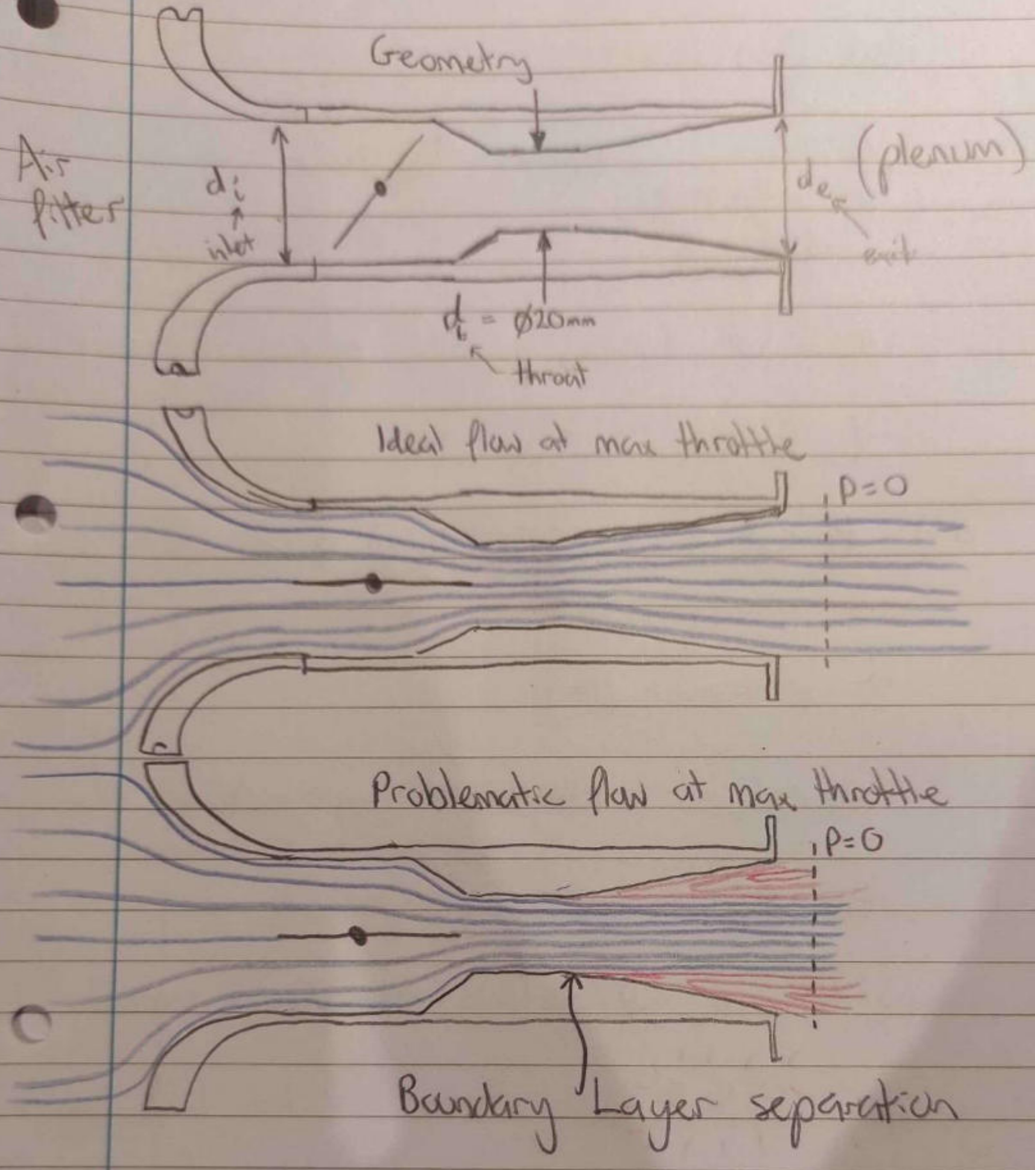
Relevant for 'ram' air effect.

## 6 Throttle body:



! Exaggerated

- Large, open mouth
- Narrows at restrictor
- low pressure gradient at diffusion region — to prevent separation, results in backpressure. This back pressure reduces pressure gradient, reducing <u>net</u> inflow of air




$$V_t = V_i \times \frac{d_i^2}{d_t^2} \quad \leftarrow \text{conservation of mass}$$

$$P_t + \tfrac{1}{2}\rho V_t^2 = P_i + \tfrac{1}{2}\rho V_i^2 \quad \leftarrow \text{conservation of energy}$$

PE/unit volume KE/unit volume

$$P_t = P_i - \tfrac{1}{2}\rho V_i^2\left(\frac{d_i^2}{d_t^2} - 1\right) \quad \leftarrow$$

combine to show $P_t < P_i$

☆ dosen't tell you any values, just difference between them ideal flow case:

$V_e = V_i$ (assuming $d_i = d_e$)

$\therefore p + \frac{1}{2}\rho V^2 = \text{const}$

$\hookrightarrow p_e = p_i$

we'll set datum pressure $p_e = 0$ (in reality this is MAP)

if $p_e = p_i = 0$

and $p_t < p_i$, $p_t < 0$ all is well with the world

in problematic flow

$d_e = d_t$ !! (bernoulli only applies to blue streamlines so use that diameter)

$p_e = p_t$

but still $p_t < p_i$ (still same upstream contraction)

$\therefore 0 < p_i$

Now we have a big high pressure zone in inlet blocking incoming flow.

This restricts the flow rate substantially

$\dot{m}_{ideal} \gg \dot{m}_{problematic}$

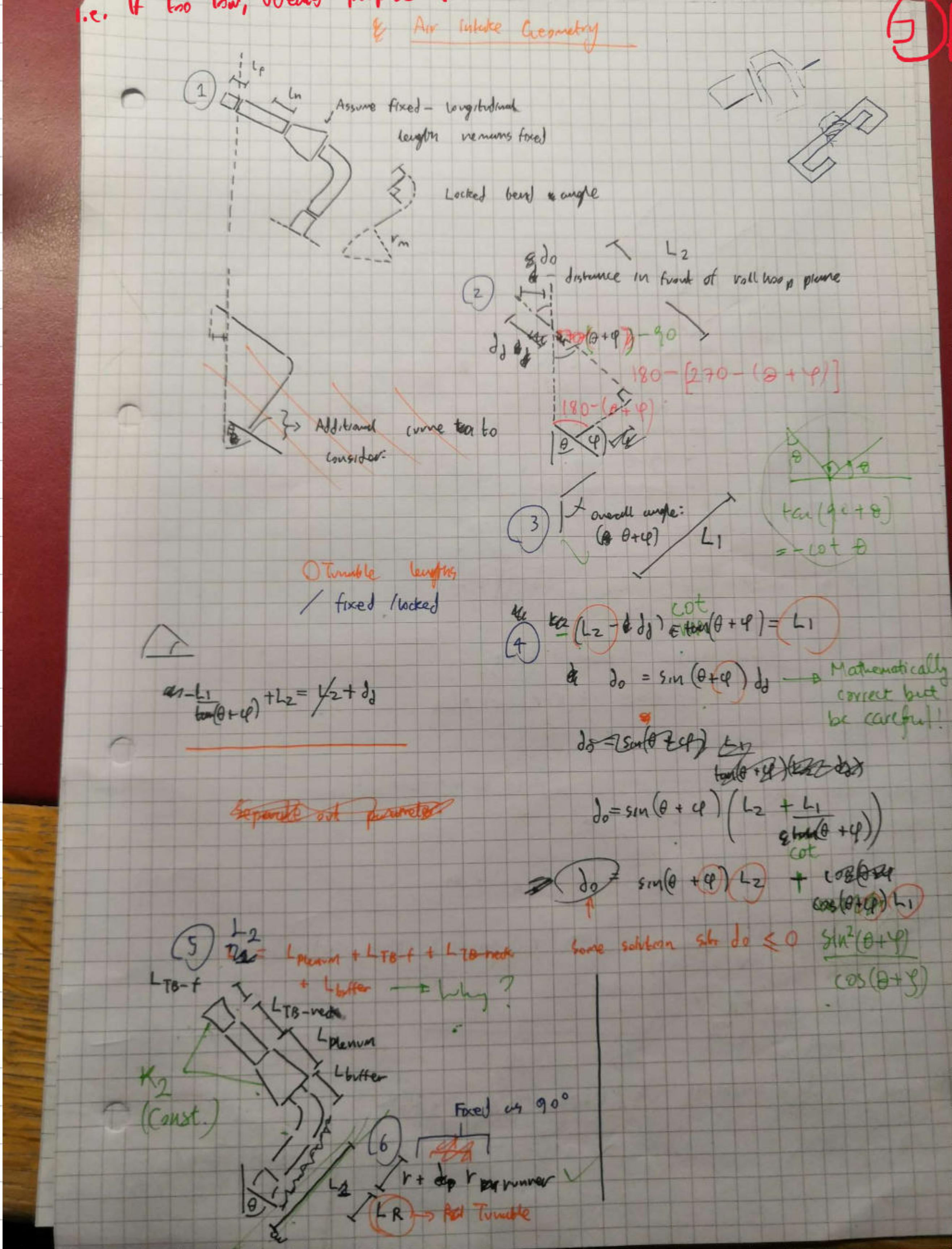
! CAN be shortened - as long as diffusion region is long and shallow

## ⑦ Parameterisation:

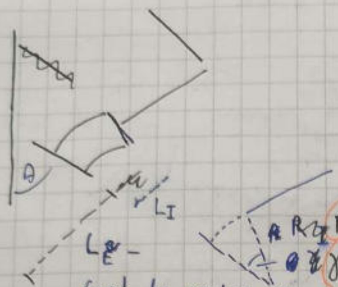
Consider some variable whcih is the horizontal overhang of the thrrottlebody an air filter in front of the rear roll hoop plane.

We can select a geometry, such that adjusting a variety of parameters: Runner straight section length, injector holer bend radius, Plenum longitundinal length etc... gives the following outputs:   (1) Overhang in x in front of rollhoop   (2)Vertical height of throttlebody mouth

i.e. If too low, defeats purpose of 'ram air' effect: too behind head rest



(7)




$L_E$ – fixed by position on intake manifold
- Engine angle
- Engine longitudinal position

$R_I$
$\gamma$

~~$L_I = R_I \gamma$~~

$L_I = R_I \gamma$ ← given in radians

(8) $d_0 = \sin(\theta + \varphi) L_2 + \underbrace{\cos(\theta + \varphi)}_{\frac{\sin^2(\theta+\varphi)}{\cos(\theta+\varphi)}} L_1$

$L_2 = L_{TB-N} + L_{Buffer} + k_2$ ? See prev. page.

(9) $L_1 = L_I + L_E + (r + r_{runner}) + L_R$

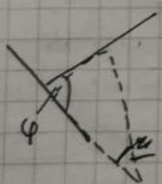
Fixed by 90° bend and dia

(11) $= L_I + L_R \quad k_1$

$R_I(\pi - 2\varphi) + L_R + k_1$

(! $\gamma$ easier to think about adjusting than $\varphi$)

(10) Injector holder angle affects $\varphi$:




$\gamma = (\pi - 2\varphi)$

$\varphi = \left(\frac{\pi - \gamma}{2}\right)$

(12) Protrusion in front of roll-hoop plane:

$d_0 = \sin\left(\theta + \frac{\pi}{2} - \frac{\gamma}{2}\right)(L_{TB-N} + L_{Buffer} + k_2)$

Most easy to adjust – just tune lengths

$- \cos\left(\theta + \frac{\pi}{2} - \frac{\gamma}{2}\right) (R_I \gamma + L_R + k_1)$