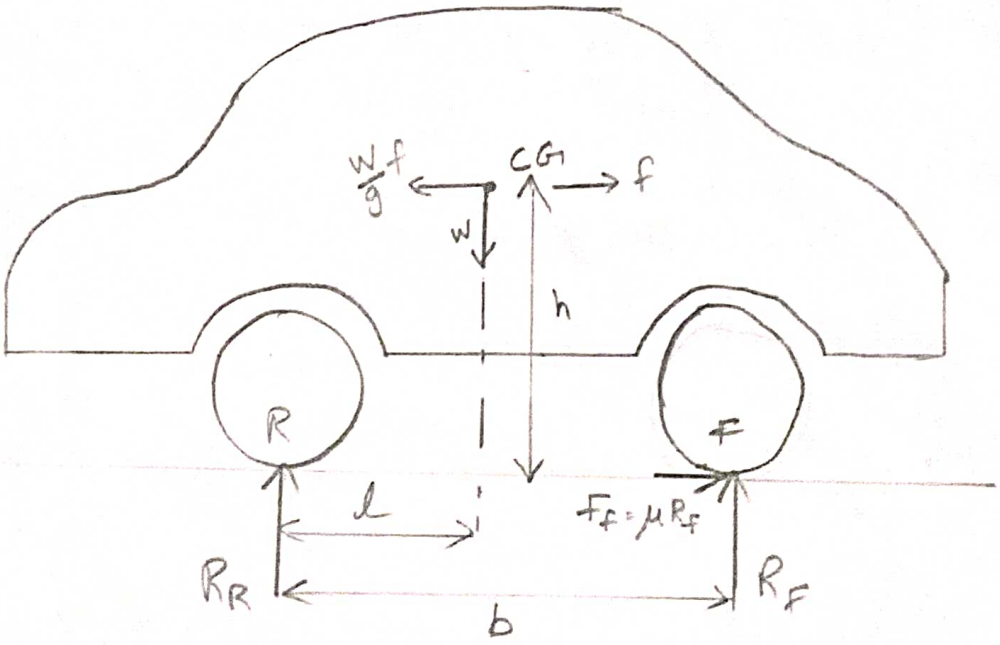
Calculation of Maximum Acceleration, Maximum Tractive effort and Reaction force for front wheel drive.



The forces acting on the vehicle and giving rise to dynamic equilibrium are shown in the figure

If

b = Wheel base

h = height of CG from the road Surface

l = distance of CG from rear axle

μ = Co efficient of adhesion between the tyres and the road Surface

R_F and R_R = Total normal reactions at front and rear wheel

W = Weight of the Car.

Then the maximum tractive effort, $F_f = \mu R_f$ produces maximum acceleration "f" and $(W/g)f$ is the inertia force opposite to acceleration "f."

Hence,

$\Sigma V = 0$ gives

$$W = R_F + R_R \longrightarrow (1)$$

$\Sigma H = 0$ gives

$$F_f = \mu R_f = \frac{W}{g} f \Rightarrow R_f = \frac{Wf}{\mu g} \longrightarrow (2)$$

$\Sigma M_R = 0$ gives

$$R_F b + (W/g) f h = W l \Rightarrow (3)$$

Sub R_f in (3)

$$\frac{Wf}{\mu g} b + \frac{W}{g} f h = W l.$$

$$\frac{W f}{g}\left[\frac{b}{\mu} + h\right] = W l$$

$$\boxed{l = \frac{f}{g}\left[\frac{b}{\mu} + h\right]}$$

~~Subs / equal~~

$$l = \frac{f}{g}\left[\frac{b+h}{\mu}\right]$$

$$l = \frac{f}{g}\left[\frac{b+\mu h}{\mu}\right].$$

$$\boxed{\frac{f}{g} = \frac{\mu l}{b+\mu h}}$$

Sub f/g in eqn (2)

$$R_F = \frac{W}{\mu} \times \frac{f}{g}$$

$$= \frac{W}{\mu}\left[\frac{\mu l}{b+\mu h}\right]$$

$$\boxed{R_F = \frac{l}{b+\mu h} W}$$

Sub R_F in (1)

$$W = R_F + R_B$$

$$W = \frac{l}{b+\mu h} W + R_R.$$

$$R_R = W - \frac{lW}{b+\mu h}$$

$$R_R = w\left[1 - \frac{l}{b+\mu h}\right]$$

$$= w\left[\frac{b+\mu h-l}{b+\mu h}\right]$$

$$\boxed{R_R = \left[\frac{b+\mu h-l}{b+\mu h}\right] w}$$