1. This may be with or without third differential.

(i) without third differential. Here both F_t and F_r come into play. Assuming that limiting friction occurs at all the four wheels simultaneously, the maximum tractive effort,

$$F = F_R + F_F = \mu R_R + \mu R_F$$

$\Sigma_V = 0$, $W = R_F + R_R$

$\Sigma_H = 0$ $\frac{W}{g} F = \mu R_R + \mu R_F = \mu (R_R + R_F) = \mu W$

$\therefore$ $$\frac{F}{g} = \mu$$

(ii) with third Differential. The torque at the front the rear wheels becomes equal with the application of third differential. Slip occurs at the wheels where the normal reaction is smaller and thus limits the tractive effort. In case, the load distribution to the front and rear wheels is equal, the slip has to occur first at the front wheels because the static normal reaction at front wheels is reduced due to inertia effect.

Thus, $\Sigma_V = 0$ gives, $W = R_R + R_F$

$\Sigma_H = 0$, gives, $\frac{W}{g} F = \mu R_R + \mu R_F$

and $\mu_s R_R = \mu R_F$ due to application of third differential, where μ_s, is the critical working coefficient of friction being $< \mu$, the limiting value.

Assuming slip to occur at front wheels first, $R_F < R_R$, then

$$2\mu R_F = \frac{W}{g} F$$

and

$$\Sigma M_R = 0 \text{ gives, } R_F b + \frac{W}{g} F h = Wl$$

Substituting the value of R_F

$$W \frac{F}{g} \frac{b}{2\mu} + W \frac{F}{g} h = Wl$$

$$\frac{F}{g} \left[\frac{b}{2\mu} + h \right] = l$$

or $$\frac{F}{g} = \frac{2\mu l}{b + 2\mu h}$$

Hence,

Solving for R_F and R_R

$$R_F = \frac{1}{b + 2\mu h} W$$

and $$R_R = \frac{b - l + 2\mu h}{b + 2\mu h} W$$

$$F = F_R + F_F = \mu R_R + \mu R_F$$
$$W = R_F + R_R$$

$\Sigma V = 0$ gives,

and $\Sigma H = 0$ gives, $\frac{W}{g} f = \mu R_R + \mu R_F = \mu (R_R + R_F) = \mu W$

Hence,
$$\frac{f}{g} = \mu$$

Thus, $\Sigma V = 0$ gives, $W = R_R + R_F$

$\Sigma H = 0$, gives. $\frac{W}{g} f = \mu R_R + \mu R_F$

and $\mu_s R_R = \mu R_F$ due to application of third differential where μ_s is the critical working coefficient of friction being $< \mu$, The limiting value.

Assuming slip to occur at front wheels first, $R_F < R_R$ then

$$2\mu R_F = \frac{W}{g} f$$

$\Sigma m_R = 0$ gives, $R_F b + \frac{W}{g} f h = W l$

Substituting the value of R_F

$$W \frac{f}{g} \frac{b}{2\mu} + W \frac{f}{g} h = W l$$

$$\frac{f}{g} \left[\frac{b}{2\mu} + h \right] = l$$

or

Hence, $\frac{f}{g} = \frac{2\mu l}{b + 2\mu h}$

Solving for R_F and R_R, $R_F = \frac{l}{b + 2\mu h} W$

and

$$R_R = \frac{b - l + 2\mu h}{b + 2\mu h} W$$

Assuming slip to occure at rear wheel, First $R_R < R_F$ then $2\mu R_R = \frac{W}{g} f$

Taking, $\Sigma m_F = 0$, $R_R b = W (b - l) + W \frac{f}{g} h$

Subtituting the value of R_R

$$W \frac{f}{g} \frac{b}{2\mu} = W (b - l) + W \frac{f}{g} h$$

or
$$\frac{f}{g} \left[\frac{b}{2\mu} - h \right] = b - l$$

Hence, $\frac{f}{g} = \frac{(b - l) 2\mu}{b - 2\mu h}$

Solving for R_R and R_F,

$$R_R = \frac{b - l}{b - 2\mu h} W$$

$$R_F = \frac{l - 2\mu h}{b - 2\mu h} W$$

2

$m = 1765\ kg$, $l = 2.84\,m$, $a_1 = 1.22\,m$, $a_2 = 1.62\,m$

Front wheel load/axies load

$$F_{ZF} = mg\left(\frac{a_2}{l}\right)$$

$$= 1765 \times 9.81\left(\frac{1.62}{2.84}\right)$$

$$= 9876.66$$

Rear wheel load/axies load

$$F_{Zr} = mg\left(\frac{a_1}{l}\right)$$

$$= 1765 \times 9.81\left(\frac{1.22}{2.84}\right)$$

$$= 7437.98$$

wheel base = $l = a_1 + a_2$

$$= 2.84$$

3. In tyre specification in the tyre side is Denoted as "195 / 55 R 16 87V"

* at that the 195 is dinoted as tyre width in mm.
* Then 55 is dinoted as side wall
* The R is known as Tyre construction
* 16 is the Rim Diameter in inches
* 87 is the Load index
* V is the known as speed

In wheel rolling without slipping there are two type of moti on is on there

i) Rotation motion

ii) Translation motion

in Rotation motion there is a velocity is created is known as "angular velocity" (ω)

$$\omega = 2\pi / t$$

$$X = 2\pi R$$

$$S = vt$$

The another motion was "Translation motion" Then that type of velocity is known as "Linear velocity" (v)

angular motion (x)

Linear motion (s)

In Dynamic roll vs slips vs skid

wheel slip :- Extra Force applied on wheel leads to more rotational velocity as compared to linear velocity.

wheel skid :- Braking force exceed the traction limit of tire and wheel lock.

In tyre which has a contact patch static, Rolling

There is a loss of Hysteresis, Blister, stiff ... etc

There is a some type of parameters on there.