

Calculation of Wishbone Forces

Vehicle Mass : $M = 400\text{kg}$

Weight Split - 45:55 front to rear

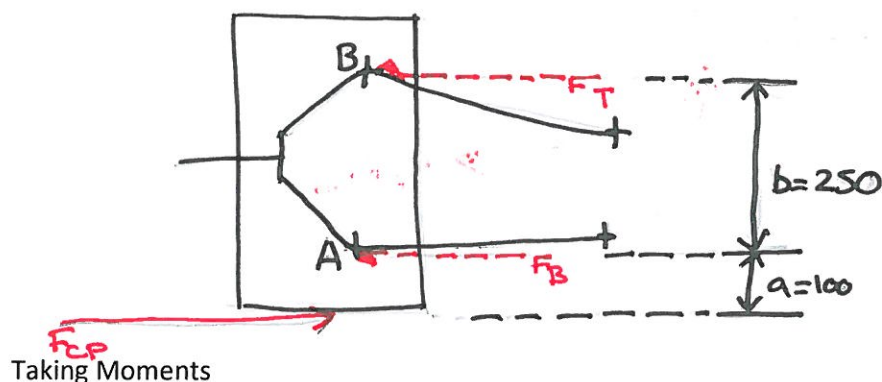
Maximum cornering 1.5G

Assume worst case is when 100% weight transfer occurs so only outside wheel is producing cornering force.

Front of vehicle

$$F = ma = (0.45 * 400) * (1.5 * 9.81)$$

$$F_{CP} = 2648\text{N}$$



Taking Moments

- About A

$$CWM = ACWM$$

$$0 = 250F_T + 100F_{CP}$$

$$F_T = \frac{-100F_{CP}}{250} = \frac{-100 * 2648}{250}$$

$$F_T = -1059.5\text{N}$$

The negative value for F_T means that it is not in compression and so the top wishbone is in **tension**.

- About B

$$CWM = ACWM$$

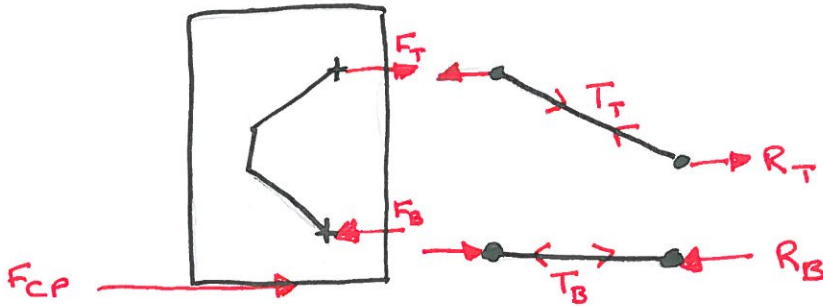
$$250F_B = 350F_{CP}$$

$$F_B = \frac{350F_{CP}}{250} = \frac{350 * 2648}{250}$$

$$F_B = +3707.2N$$

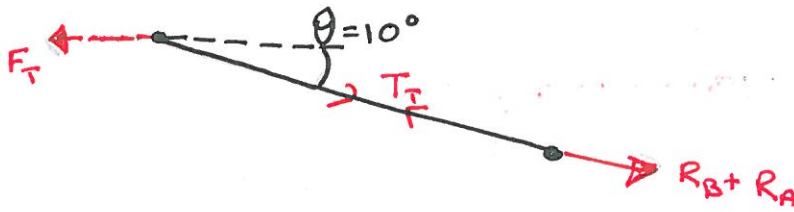
Positive value indicates the lower wishbone is in compression.

We can check our moment calculations by checking all forces acting horizontally on the hub add up to zero



We then consider one wishbone at a time.

- Top Wishbone



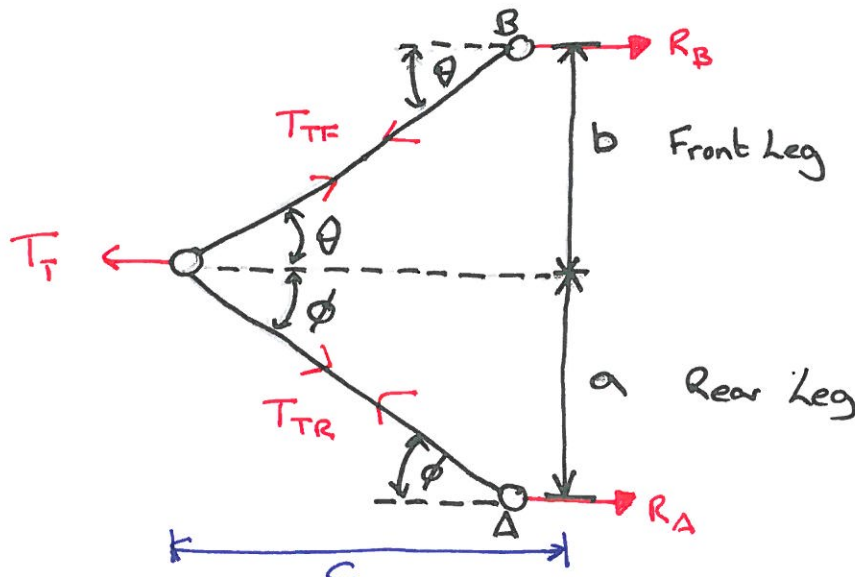
Hub applies horizontal tension force to top wishbone F_T which results in the top wishbone undergoing a tension T_T .

$$T_T \cos \theta = F_T$$

$$T_T = \frac{F_T}{\cos \theta} = \frac{1059.5}{\cos(10)} = 1075.3N$$

Wishbones have 2 legs which each contribute to the tension capability of the wishbone.

Looking from above wishbone plane.



Taking Moments

- About A

$$(a + b)R_B = aT_T$$

$$R_B = \frac{aT_T}{a + b}$$

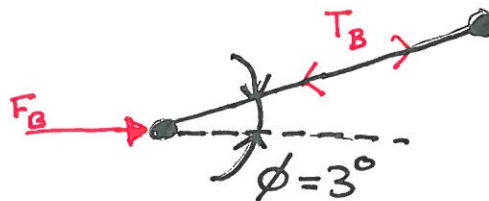
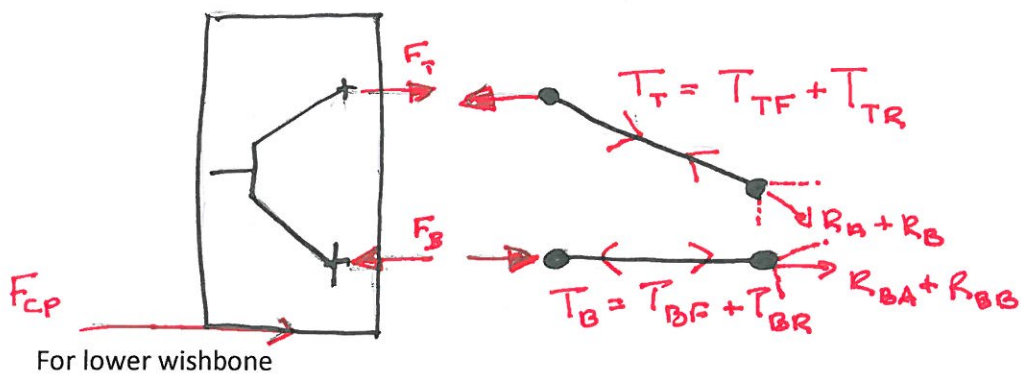
$$T_{TF} = \frac{R_B}{\cos \theta} = \frac{aT_T}{(a + b) \cos \theta}$$

- About B

$$bT_T = (a + b)R_A$$

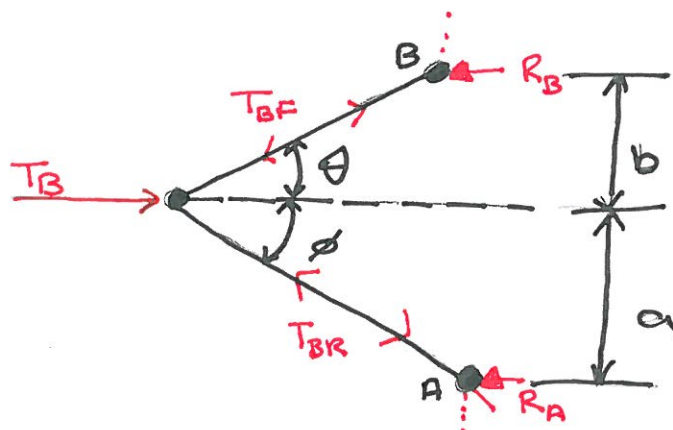
$$R_A = \frac{bT_T}{(a + b)}$$

$$T_{TR} = \frac{R_A}{\cos \phi} = \frac{bT_T}{(a + b) \cos \phi}$$



$$T_B \cos(3) = F_B$$

$$T_B = \frac{F_B}{\cos(3)} = \frac{3707.5}{\cos(3)} = 3712.6N$$



Taking Moments

- About A

$$(a + b)R_B = aT_B$$
$$R_B = \frac{aT_B}{a + b}$$
$$T_{BF} = \frac{R_B}{\cos \theta} = \frac{aT_B}{(a + b) \cos \theta}$$

- About B

$$(a + b)R_A = bT_B$$
$$R_A = \frac{bT_B}{a + b}$$
$$T_{BF} = \frac{R_A}{\cos \phi} = \frac{bT_B}{(a + b) \cos \phi}$$



Example

Top Wishbone

$$a=150$$

$$b=160$$

$$\theta = \tan^{-1}\left(\frac{160}{300}\right) = 28.07^\circ$$

$$\phi = \tan^{-1}\left(\frac{150}{300}\right) = 26.57^\circ$$

$$T_{TF} = \frac{aT_T}{(a+b)\cos\theta} = \frac{0.15 * 1075.3}{(0.15 + 0.16)\cos(28.07)} = 589.7N$$

$$T_{TR} = \frac{bT_T}{(a+b)\cos\phi} = \frac{0.16 * 1075.3}{(0.15 + 0.16)\cos 26.57} = 620.53N$$

Bottom Wishbone

$$a=150$$

$$b=160$$

$$c=300$$

$$\theta = 28.07^\circ$$

$$\phi = 26.57^\circ$$

$$T_{BF} = \frac{aC_B}{(a+b)\cos\theta} = \frac{0.15 * 3712.6}{(0.15 + 0.16)\cos(28.07)} = 2035.9N$$

$$T_{BR} = \frac{bC_B}{(a+b)\cos\phi} = \frac{0.16 * 3712.6}{(0.15 + 0.16)\cos 26.57} = 2142.45N$$

