

Calculation of wishbone forces Example

Vehicle Mass $:(m) = 400 \text{ kg}$

Weight Split 45:55 front to rear.

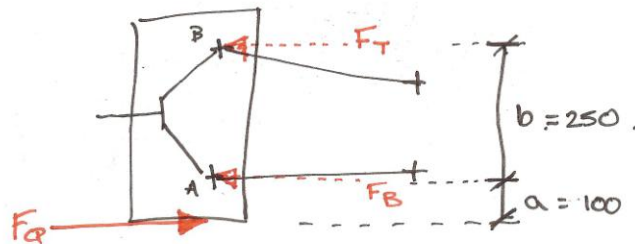
maximum cornering 1.5g.

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

FRONT OF VEHICLE.

$$F = ma = (0.45 \times 400) \times (1.5 \times 9.81).$$

$$F_{cp} = 2648 \text{ N}.$$



Taking moments:

$\sum A$

$$C_{LWM} = A_{CWM}$$

$$0 = 250 F_T + 100 F_{cp}.$$

$$F_T = -\frac{100 F_{cp}}{250} = -\frac{100 \times 2648}{250}$$

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

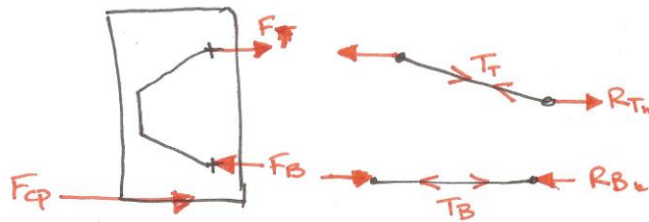
Not in compression so this negative shows top wishbone in tension.

$$\sum \vec{F}_B \text{ cwm} = A \text{ cwm}$$

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

$$F_B = \frac{350 F_{cp}}{250} = \frac{350 \times 2648}{250} = \textcircled{+} 3707.2 \text{ N.}$$

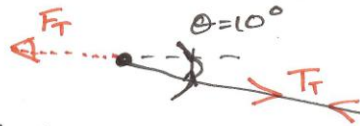
Positive indicates lower wishbone in compression



- 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:



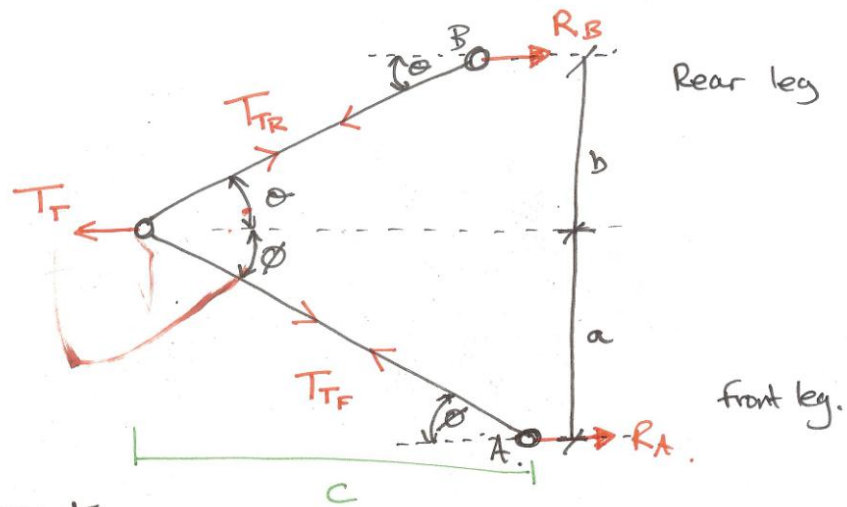
Hub applies horizontal tension force to top wishbone F_T which results in the top wishbone undergoing a tension T_T .

$$T_T \cos \theta = F_T$$

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

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

looking from above wishbone plane.



Taking moments.

$\sum \vec{A}$

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

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

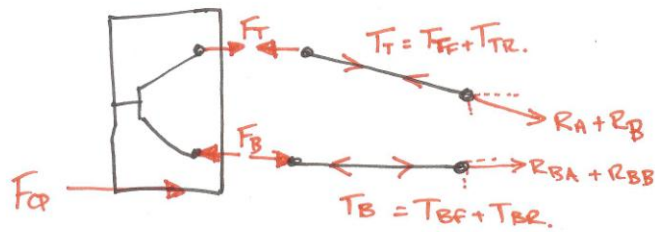
$$T_{TR} = \frac{R_B}{\cos \phi} = \frac{a T_T}{(a+b) \cos \phi}$$

$\sum \vec{B}$

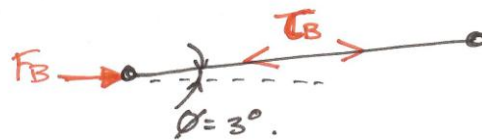
$$b T_T = (a+b) R_A$$

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

$$T_{TF} = \frac{R_A}{\cos \phi} = \frac{b T_T}{(a+b) \cos \phi}$$

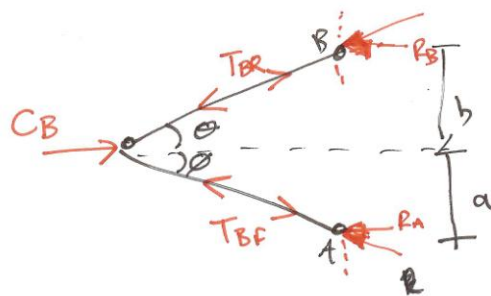


for lower wishbone:



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

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



Taking moments

$$\sum \vec{A} \quad (a+b) R_B = a C_B$$

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

$$T_{BR} = \frac{R_B}{\cos \theta} = \frac{a C_B}{(a+b) \cos \theta}.$$

$$\sum \vec{B} \quad (a+b) R_A = b C_B$$

$$R_A = \frac{b C_B}{a+b}$$

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

Top Wishbone

$$a = 150$$

$$b = 160$$

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

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

$$c = 300$$

$$T_{TR} = \frac{a T_T}{(a+b) \cos \theta} = \frac{0.15 \times 1075.3}{(0.15+0.16) \cos(28.07)} = \underline{589.7 \text{ N}}$$

$$T_{TF} = \frac{b T_T}{(a+b) \cos \phi} = \frac{0.16 \times 1075.3}{(0.15+0.16) \cos(26.57)} = \underline{620.53 \text{ N}}$$

Bottom Wishbone

$$a = 150$$

$$b = 160$$

$$c = 300$$

$$\theta = 28.07$$

$$\phi = 26.57$$

$$C_{BL} = \frac{a C_B}{(a+b) \cos \theta} = \frac{0.15 \times 3712.6}{(0.15+0.16) \cos 28.07} = \underline{2035.9 \text{ N}}$$

$$C_{BF} = \frac{b C_B}{(a+b) \cos \phi} = \frac{0.16 \times 3712.6}{(0.15+0.16) \cos 26.57} = \underline{2142.45}$$

