Suspension Formula Cheatsheet

Front-Rear Distribution %

Percentage of a given quantity distributed towards the front axle

$$\frac{\text{Front\_quantity}}{\text{(Front\_quantity + Rear\_Quantity)}} \times 100$$

Undamped Natural Frequency

For calculating the undamped natural frequency of single corner of the car in heave

$$k_{Wheel} = m \times 4\pi^2 \times \omega^2 \qquad \omega = \frac{1}{2\pi} \times \sqrt{\frac{k_{Wheel}}{m}}$$

Where:

ω = undamped natural frequency of single corner of car in Hz
k_{Wheel} = spring stiffness at wheel of single corner in N/m
m = sprung mass supported by that corner of the car in kg

Motion Ratio & Spring Rate

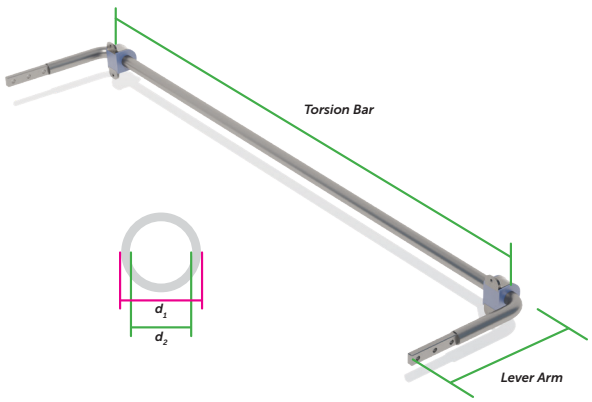
$$MR_{\text{Wheel to ARB}} = \frac{\text{Displacement}_{\text{Wheel}}}{\text{Displacement}_{\text{ARB}}}$$

$$MR_{\text{Wheel to Spring}} = \frac{\text{Displacement}_{\text{Wheel}}}{\text{Displacement}_{\text{Spring}}}$$

$$\text{Spring Rate } (K_{spring}) = \text{Wheel Rate } (K_{wheel}) \times MR^2$$

Relevant Unit Conversions

Weight:	1 kg	= 2.21 lbs
Stiffness:	1 N/m	= 1/1000 N/mm
	1 kg/mm	= 9.81 N/mm
	1 lb/in	= 0.175 N/mm



Anti-Roll Bar Stiffness - (U-Bar)

For calculating the stiffness of a typical U-style anti-roll bar.

Lever Arm Stiffness:

$$k_L = \frac{(3*E*I)}{L^3}$$

Where:

k_L = Stiffness of a single lever arm
E = Youngs modulus of material in Pa (~200E9 Pa for steel)
I = Second moment of area in m^4 (see formula below)
L = Length of cantilever in m

$$I = \frac{Pi(d_1^4 - d_2^4)}{64}$$

Where:

d_1 = External diameter of lever arm in m
d_2 = Internal diameter of lever arm in m (use zero if bar is solid)

Torsional Section Stiffness:

$$k_T = \frac{(G*J)}{(r^2*L)}$$

Where:

k_T = Torsion bar stiffness
G = Torsional modulus of rigidity in Pa (~80E9 Pa for steel)
J = Polar second moment of area in m^4 (see formula below)
r = Length of one of the lever arms in m
L = length of torsion bar in m

$$J = \frac{Pi(d_1^4 - d_2^4)}{32}$$

Where:

d_1 = External diameter of lever arm in m
d_2 = Internal diameter of lever arm in m (use zero if bar is solid)

Total Anti-Roll Bar Stiffness:

$$\frac{1}{k_{\text{Total ARB}}} = \frac{1}{k_L} + \frac{1}{k_L} + \frac{1}{k_T}$$

After calculating the result of the right side of the above equation, invert the answer to find the total ARB stiffness (k_{Total_ARB})