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Wheel Parameters Formulas

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List of 20 Wheel Parameters Formulas

Wheel Parameters

1) Angle between Traction Force and Horizontal Axis

Open Calculator

fx $$\theta = a\sin\left(1 - \frac{h_{curb}}{r_d}\right)$$

ex $$0.689775\text{rad} = a\sin\left(1 - \frac{0.2\text{m}}{0.55\text{m}}\right)$$

2) Aspect Ratio of Tire

Open Calculator

fx $$AR = \frac{H}{W} \cdot 100$$

ex $$54.66667 = \frac{0.123\text{m}}{0.225\text{m}} \cdot 100$$

3) Circumference of Wheel

Open Calculator

fx $$C = 3.1415 \cdot d_w$$

ex $$2.13622\text{m} = 3.1415 \cdot 0.680\text{m}$$

4) Contact Point of Wheel and Curb Distance from Wheel Center Axis

Open Calculator

fx $$s = \sqrt{2 \cdot r_d \cdot \left(h - h^2\right)}$$

ex $$0.363923\text{m} = \sqrt{2 \cdot 0.55\text{m} \cdot \left(0.14\text{m} - (0.14\text{m})^2\right)}$$

5) Damper angle from Vertical given wheel rate

Open Calculator

$$\Phi = a\cos\left(\frac{K_t}{K\cdot\left(IR^2\right)}\right)$$

$$89.62^\circ = a\cos\left(\frac{100\text{N/m}}{60311.79\text{N/m}\cdot\left(\left(0.5\right)^2\right)}\right)$$

6) Height of Center of Gravity of Vehicle by method of jacking Vehicle from Rear

Open Calculator

$$h_{cg} = \left(R_{LF}\cdot\left(\frac{c}{b}\right)\right) + \left(R_{LR}\cdot\left(\frac{a_{cg}}{b}\right)\right) + \left(\frac{\left(W_F\cdot b\right)-\left(m\cdot c\right)}{m\cdot\tan\left(\theta_a\right)}\right)$$

$$1480.92\text{in} = \left(11\text{in}\cdot\left(\frac{30\text{in}}{2.7\text{m}}\right)\right) + \left(15\text{in}\cdot\left(\frac{27\text{in}}{2.7\text{m}}\right)\right) + \left(\frac{\left(150\text{kg}\cdot 2.7\text{m}\right)-\left(55\text{kg}\cdot 30\text{in}\right)}{55\text{kg}\cdot\tan\left(10^\circ\right)}\right)$$

7) Installation Ratio given Wheel Rate

Open Calculator

$$IR = \sqrt{\frac{K_t}{K\cdot\cos\left(\Phi\right)}}$$

$$0.5 = \sqrt{\frac{100\text{N/m}}{60311.79\text{N/m}\cdot\cos\left(89.62^\circ\right)}}$$

8) Ride rate of car

Open Calculator

$$K_{RR} = \frac{K_t\cdot K_{tr}}{K_t + K_{tr}}$$

$$9.9991\text{N/m} = \frac{100\text{N/m}\cdot 11.11\text{N/m}}{100\text{N/m} + 11.11\text{N/m}}$$

9) Spring angle correction factor

Open Calculator

$$\cos\theta = \cos(\theta_s)$$

$$0.866025 = \cos(30.0^\circ)$$

10) Spring rate given wheel rate

Open Calculator

$$K = \frac{K_t}{(IR^2) \cdot \cos(\Phi)}$$

$$60311.79\text{N/m} = \frac{100\text{N/m}}{\left((0.5)^2\right) \cdot \cos(89.62^\circ)}$$

11) Spring rate required for coilover given desired droop and motion ratio

Open Calculator

$$k = W_{cs} \cdot \frac{g}{M.R. \cdot W.T. \cdot \cos(\theta_s)}$$

$$160.8213\text{N/m} = 1.208\text{kg} \cdot \frac{9.8\text{m/s}^2}{0.85 \cdot 100.0\text{mm} \cdot \cos(30.0^\circ)}$$

12) Stiffness of Spring provided Wheel rate

Open Calculator

$$k = \frac{K_t}{\left((M.R.)^2\right) \cdot (\cos\theta)}$$

$$160.8931\text{N/m} = \frac{100\text{N/m}}{\left((0.85)^2\right) \cdot (0.86025)}$$

13) Tire Rate given Wheel Rate and Ride Rate

Open Calculator

$$K_{tr} = \frac{K_t \cdot K_{RR}}{K_t - K_{RR}}$$

$$11.11\text{N/m} = \frac{100\text{N/m} \cdot 9.9991\text{N/m}}{100\text{N/m} - 9.9991\text{N/m}}$$

14) Tire Side Wall Height

Open Calculator

$$H = \frac{AR \cdot W}{100}$$

$$0.123\text{m} = \frac{54.66667 \cdot 0.225\text{m}}{100}$$

15) Track Width of Vehicle given Wheel rate and Roll rate

Open Calculator

$$a = \sqrt{\frac{2 \cdot K_\Phi}{K_t}}$$

$$1.2\text{m} = \sqrt{\frac{2 \cdot 72\text{Nm/rad}}{100\text{N/m}}}$$

16) Wheel Diameter of Vehicle

Open Calculator

$$d_w = D + 2 \cdot H$$

$$0.68\text{m} = 0.434\text{m} + 2 \cdot 0.123\text{m}$$

17) Wheel Radius of Vehicle

Open Calculator

$$r_w = \frac{d_w}{2}$$

$$0.34\text{m} = \frac{0.680\text{m}}{2}$$

18) Wheel rate

Open Calculator

$$K_t = K \cdot \left(IR^2\right) \cdot \cos(\Phi)$$

$$100\text{N/m} = 60311.79\text{N/m} \cdot \left((0.5)^2\right) \cdot \cos(89.62^\circ)$$

19) Wheel Rate given Tire Rate and Ride Rate

Open Calculator

fx $$K_t = \frac{K_{tr} \cdot K_{RR}}{K_{tr} - K_{RR}}$$

ex $$100\text{N/m} = \frac{11.11\text{N/m} \cdot 9.9991\text{N/m}}{11.11\text{N/m} - 9.9991\text{N/m}}$$

20) Wheel rate in vehicle

Open Calculator

fx $$K_t = k \cdot \left((M.R.)^2\right) \cdot (\cos\theta)$$

ex $$100.0001\text{N/m} = 160.8932\text{N/m} \cdot \left((0.85)^2\right) \cdot (0.86025)$$

Variables Used

- **a** Track Width of Vehicle *(Meter)*
- a_{cg} Horizontal Distance of C.G. From Front Axle *(Inch)*
- **AR** Aspect Ratio of Tire
- **b** Wheelbase of Vehicle *(Meter)*
- **c** Horizontal Distance of C.G. From Rear Axle *(Inch)*
- **C** Wheel Circumference *(Meter)*
- **cosθ** Spring Angle Correction Factor
- **D** Rim Diameter *(Meter)*
- d_w Wheel Diameter of Vehicle *(Meter)*
- **g** Acceleration due to Gravity *(Meter per Square Second)*
- **h** Height of Curb *(Meter)*
- **H** Tire Side Wall Height *(Meter)*
- h_{cg} Height of Center of Gravity (C.G.) of Vehicle *(Inch)*
- h_{curb} Curb Height *(Meter)*
- **IR** Installation Ratio
- **k** Stiffness of Spring *(Newton per Meter)*
- **K** Spring Rate *(Newton per Meter)*
- K_{RR} Ride Rate of Car *(Newton per Meter)*
- K_t Wheel Rate of Vehicle *(Newton per Meter)*
- K_{tr} Tire Rate *(Newton per Meter)*
- K_Φ Roll Rate/ Roll Stiffness *(Newton Meter per Radian)*
- **m** Mass of Vehicle *(Kilogram)*
- **M.R.** Motion Ratio in Suspension
- r_d Effective Radius of Wheel *(Meter)*
- R_{LF} Loaded Radius of Front Wheels *(Inch)*
- R_{LR} Loaded Radius of Rear Wheels *(Inch)*
- r_w Wheel Radius in Meter *(Meter)*
- **s** Contact Point Distance from Wheel Center Axis *(Meter)*
- **W** Tire Width *(Meter)*

- W_{cs} Corner Sprung Mass of Vehicle *(Kilogram)*
- W_F Weight of Front Wheels with Rear Elevated *(Kilogram)*
- **W.T.** Wheel Travel *(Millimeter)*
- θ Angle between Traction Force and Horizontal Axis *(Radian)*
- θ_a Angle through which Rear Axle of Vehicle Raised *(Degree)*
- θ_s Angle of Spring/Shock Absorber from Vertical *(Degree)*
- Φ Damper Angle from Vertical *(Degree)*

Constants, Functions, Measurements used

- Function: **acos**, acos(Number)
  The inverse cosine function, is the inverse function of the cosine function. It is the function that takes a ratio as an input and returns the angle whose cosine is equal to that ratio.
- Function: **asin**, asin(Number)
  The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Function: **tan**, tan(Angle)
  The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: **Length** in Meter (m), Inch (in), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Angle** in Radian (rad), Degree (°)
  Angle Unit Conversion
- Measurement: **Surface Tension** in Newton per Meter (N/m)
  Surface Tension Unit Conversion
- Measurement: **Torsion Constant** in Newton Meter per Radian (Nm/rad)
  Torsion Constant Unit Conversion

Check other formula lists

- **Angular Velocity Formulas**
- **Tire Rolling and Slipping Formulas**
- **Wheel Parameters Formulas**

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