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# Turning Dynamics Formulas

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# List of 17 Turning Dynamics Formulas

## Turning Dynamics

### 1) Pivot Centre given Turning Radius of Inner Front Wheel

$$\text{fx } c = a_{tw} - 2 \cdot \left( \frac{b}{\sin(\theta)} - R_{if} \right)$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

$$\text{ex } 1300.091\text{mm} = 1999\text{mm} - 2 \cdot \left( \frac{2700\text{mm}}{\sin(40^\circ)} - 3851\text{mm} \right)$$

### 2) Pivot Centre given Turning Radius of Inner Rear Wheel

$$\text{fx } c = a_{tw} - 2 \cdot \left( \frac{b}{\tan(\theta)} - R_{ir} \right)$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

$$\text{ex } 1363.531\text{mm} = 1999\text{mm} - 2 \cdot \left( \frac{2700\text{mm}}{\tan(40^\circ)} - 2900\text{mm} \right)$$

### 3) Pivot Centre given Turning Radius of Outer Front Wheel

$$\text{fx } c = a_{tw} - 2 \cdot \left( -\frac{b}{\sin(\varphi)} + R_{of} \right)$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d\_img.jpg\)](#)

$$\text{ex } 2579\text{mm} = 1999\text{mm} - 2 \cdot \left( -\frac{2700\text{mm}}{\sin(30^\circ)} + 5110\text{mm} \right)$$



#### 4) Pivot Centre given Turning Radius of Outer Rear Wheel

$$fx \quad c = a_{tw} - 2 \cdot \left( -\frac{b}{\tan(\varphi)} + R_{or} \right)$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$ex \quad 1352.074\text{mm} = 1999\text{mm} - 2 \cdot \left( -\frac{2700\text{mm}}{\tan(30^\circ)} + 5000\text{mm} \right)$$

#### 5) Turning radius of car when taking turn

$$fx \quad R_t = \frac{b}{2 \cdot \sin(\delta)}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 4291.62\text{mm} = \frac{2700\text{mm}}{2 \cdot \sin(0.32\text{rad})}$$

#### 6) Turning radius of front inner wheel while cornering

$$fx \quad R_i = \left( \frac{b}{\sin(\theta)} \right) - \left( \frac{a_{tw} - c}{2} \right)$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$ex \quad 3850.954\text{mm} = \left( \frac{2700\text{mm}}{\sin(40^\circ)} \right) - \left( \frac{1999\text{mm} - 1300\text{mm}}{2} \right)$$


#### 7) Turning radius of outer front wheel while cornering

$$fx \quad R_{of} = \left( \frac{b}{\sin(\varphi)} \right) + \left( \frac{a_{tw} - c}{2} \right)$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$ex \quad 5749.5\text{mm} = \left( \frac{2700\text{mm}}{\sin(30^\circ)} \right) + \left( \frac{1999\text{mm} - 1300\text{mm}}{2} \right)$$



8) Turning radius of outer rear wheel while cornering 

$$fx \quad R_{or} = \left( \frac{b}{\tan(\varphi)} \right) + \left( \frac{a_{tw} - c}{2} \right)$$

Open Calculator 

$$ex \quad 5026.037\text{mm} = \left( \frac{2700\text{mm}}{\tan(30^\circ)} \right) + \left( \frac{1999\text{mm} - 1300\text{mm}}{2} \right)$$

9) Turning radius of rear inner wheel while cornering 

$$fx \quad R_{ir} = \left( \frac{b}{\tan(\theta)} \right) - \left( \frac{a_{tw} - c}{2} \right)$$

Open Calculator 

$$ex \quad 2868.235\text{mm} = \left( \frac{2700\text{mm}}{\tan(40^\circ)} \right) - \left( \frac{1999\text{mm} - 1300\text{mm}}{2} \right)$$

10) Wheel Base given Turning Radius of Inner Front Wheel 

$$fx \quad b = \left( R_{if} + \frac{a_{tw} - c}{2} \right) \cdot \sin(\theta)$$

Open Calculator 

$$ex \quad 2700.029\text{mm} = \left( 3851\text{mm} + \frac{1999\text{mm} - 1300\text{mm}}{2} \right) \cdot \sin(40^\circ)$$

11) Wheel Base given Turning Radius of Inner Rear Wheel 

$$fx \quad b = \left( R_{ir} + \frac{a_{tw} - c}{2} \right) \cdot \tan(\theta)$$

Open Calculator 

$$ex \quad 2726.654\text{mm} = \left( 2900\text{mm} + \frac{1999\text{mm} - 1300\text{mm}}{2} \right) \cdot \tan(40^\circ)$$



12) Wheel Base given Turning Radius of Outer Front Wheel [Open Calculator](#) 

$$fx \quad b = \left( R_{of} - \frac{a_{tw} - c}{2} \right) \cdot \sin(\varphi)$$

$$ex \quad 2380.25\text{mm} = \left( 5110\text{mm} - \frac{1999\text{mm} - 1300\text{mm}}{2} \right) \cdot \sin(30^\circ)$$

13) Wheel Base given Turning Radius of Outer Rear Wheel [Open Calculator](#) 

$$fx \quad b = \left( R_{or} - \frac{a_{tw} - c}{2} \right) \cdot \tan(\varphi)$$

$$ex \quad 2684.967\text{mm} = \left( 5000\text{mm} - \frac{1999\text{mm} - 1300\text{mm}}{2} \right) \cdot \tan(30^\circ)$$

14) Wheel Track given Turning Radius of Inner Front Wheel [Open Calculator](#) 

$$fx \quad a_{tw} = 2 \cdot \left( \frac{b}{\sin(\theta)} - R_{if} \right) + c$$

$$ex \quad 1998.909\text{mm} = 2 \cdot \left( \frac{2700\text{mm}}{\sin(40^\circ)} - 3851\text{mm} \right) + 1300\text{mm}$$

15) Wheel Track given Turning Radius of Inner Rear Wheel [Open Calculator](#) 

$$fx \quad a_{tw} = 2 \cdot \left( \frac{b}{\tan(\theta)} - R_{ir} \right) + c$$

$$ex \quad 1935.469\text{mm} = 2 \cdot \left( \frac{2700\text{mm}}{\tan(40^\circ)} - 2900\text{mm} \right) + 1300\text{mm}$$



16) Wheel Track given Turning Radius of Outer Front Wheel 

$$fx \quad a_{tw} = 2 \cdot \left( -\frac{b}{\sin(\varphi)} + R_{of} \right) + c$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

$$ex \quad 720\text{mm} = 2 \cdot \left( -\frac{2700\text{mm}}{\sin(30^\circ)} + 5110\text{mm} \right) + 1300\text{mm}$$

17) Wheel Track given Turning Radius of Outer Rear Wheel 

$$fx \quad a_{tw} = 2 \cdot \left( -\frac{b}{\tan(\varphi)} + R_{or} \right) + c$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$ex \quad 1946.926\text{mm} = 2 \cdot \left( -\frac{2700\text{mm}}{\tan(30^\circ)} + 5000\text{mm} \right) + 1300\text{mm}$$





## Variables Used

- $a_{tw}$  Track Width of Vehicle (Millimeter)
- $b$  Wheelbase of Vehicle (Millimeter)
- $c$  Distance between Front Wheel Pivot Center (Millimeter)
- $R_i$  Turning Radius of Inner Wheel (Millimeter)
- $R_{if}$  Turning Radius of Inner Front Wheel (Millimeter)
- $R_{ir}$  Turning Radius of Inner Rear Wheel (Millimeter)
- $R_{of}$  Turning Radius of Outer Front Wheel (Millimeter)
- $R_{or}$  Turning Radius of Outer Rear Wheel (Millimeter)
- $R_t$  Turning Radius of Car (Millimeter)
- $\delta$  Steer Angle (Radian)
- $\theta$  Angle of Inside Wheel Lock (Degree)
- $\varphi$  Angle of Outside Wheel Lock (Degree)



## Constants, Functions, Measurements used

- **Function:** **sin**,  $\sin(\text{Angle})$   
*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:** **tan**,  $\tan(\text{Angle})$   
*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 Millimeter (mm)  
*Length Unit Conversion* 
- **Measurement:** **Angle** in Degree ( $^{\circ}$ ), Radian (rad)  
*Angle Unit Conversion* 





## Check other formula lists

- [Forces on Steering System and Axles Formulas](#) 
- [Movement Ratio Formulas](#) 
- [Steering System Formulas](#) 
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