



Railway Track and Track Stresses Formulas

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Conversions!

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List of 27 Railway Track and Track Stresses Formulas

Railway Track and Track Stresses &

Lap of Flange

1) Diameter of Wheel given Lap of Flange

$$D = rac{\left(rac{L}{2}
ight)^2 - H^2}{H}$$

ex $11.25 ext{mm} = rac{\left(rac{50 ext{mm}}{2}
ight)^2 - \left(20 ext{mm}
ight)^2}{20 ext{mm}}$

$$W_{
m e} = \left(W + L^2
ight) \cdot rac{125}{R}$$

 $oxed{ex} 2.180233 \mathrm{mm} = \left(3500 \mathrm{mm} + (50 \mathrm{mm})^2
ight) \cdot rac{125}{344 \mathrm{m}}$

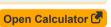
$$\mathbf{L} = 2 \cdot \left((\mathrm{D} \cdot \mathrm{H}) + \mathrm{H}^2
ight)^{0.5}$$

 $\boxed{\textbf{50mm} = 2 \cdot \left(\left(11.25 \text{mm} \cdot 20 \text{mm}\right) + \left(20 \text{mm}\right)^2 \right)^{0.5}}$



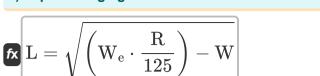
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4) Lap of Flange given Extra Width of Track



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$$=$$
 $\sqrt{\left(2.18 \mathrm{mm} \cdot \frac{344 \mathrm{m}}{125}\right) - 3500 \mathrm{mm}}$

5) Radius of Curve given Extra Width



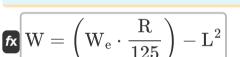
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 $\mathbf{ex} \ 344.0367 \mathrm{m} = \left(3500 \mathrm{mm} + (50 \mathrm{mm})^2\right) \cdot \frac{125}{2.18 \mathrm{mm}}$



Lateral Forces

$$I = W_L \cdot rac{S}{z \cdot I_{max}}$$







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8) Maximum Contact Shear Stress

, , 1

 $\left| \mathbf{F}_{\mathrm{s}} = 4.13 \cdot \left(rac{\mathbf{F}_{\mathrm{a}}}{\mathrm{R}_{\mathrm{w}}}
ight)^{rac{1}{2}}
ight|$

 $9.121644 \text{kgf/mm}^2 = 4.13 \cdot \left(\frac{200 \text{tf}}{41 \text{mm}}\right)^{\frac{1}{2}}$

9) Maximum Load on Rail Seat

 $\mathbf{L}_{ ext{max}} = \mathbf{W}_{ ext{L}} \cdot rac{ ext{S}}{ ext{z} \cdot ext{I}}$

 $= 499.905 \text{kN} = 43.47 \text{kN} \cdot \frac{2.3 \text{m}}{0.0125 \text{m}^3 \cdot 16 \text{m}}$

10) Radius of Wheel given Shear Stress

 $\mathbf{R}_{\mathrm{w}} = \left(rac{4.13}{\mathrm{F}_{\mathrm{s}}}
ight)^2 \cdot \mathrm{F}_{\mathrm{a}}$

= $\left(\frac{4.13}{9.2 \text{kgf/mm}^2}\right)^2 \cdot 200 \text{tf}$

11) Section Modulus of Rail given Seat Load

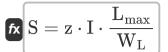
 $\mathbf{z} = rac{\mathrm{W_L \cdot S}}{\mathrm{T \cdot L_{max}}}$

 $0.012498 \mathrm{m}^{_{3}} = rac{43.47 \mathrm{kN} \cdot 2.3 \mathrm{m}}{16 \mathrm{m} \cdot 500 \mathrm{kN}}$





12) Sleeper Spacing given Seat Load on Rail



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$$\mathbf{ex} \ 2.300437 \mathrm{m} = 0.0125 \mathrm{m}^{_3} \cdot 16 \mathrm{m} \cdot rac{500 \mathrm{kN}}{43.47 \mathrm{kN}}$$

13) Static Wheel Load given Shear Stress

$$\mathbf{F}_{\mathrm{a}} = \left(rac{\mathrm{F}_{\mathrm{s}}}{4.13}
ight)^2 \cdot \mathrm{R}_{\mathrm{w}}$$

Open Calculator

$$ext{ex} \ 203.4508 ext{tf} = \left(rac{9.2 ext{kgf/mm}^2}{4.13}
ight)^2 \cdot 41 ext{mm}$$

14) Wheel Load given Seat Load 🖸

$$W_{L} = z \cdot I \cdot rac{L_{max}}{S}$$

Open Calculator

$$=$$
 43.47826kN = $0.0125 \mathrm{m}^3 \cdot 16 \mathrm{m} \cdot \frac{500 \mathrm{kN}}{2.3 \mathrm{m}}$



Vertical Loads

fx

15) Bending Moment on Rail

 $\mathrm{M} = 0.25 \cdot \mathrm{L_{Vertical}} \cdot \mathrm{exp} \Big(- \frac{\mathrm{x}}{\mathrm{1}} \Big) \cdot \Big(\mathrm{sin} \Big(\frac{\mathrm{x}}{\mathrm{1}} \Big) - \mathrm{cos} \Big(\frac{\mathrm{x}}{\mathrm{1}} \Big) \Big)$

ex

 $1.575269N*m = 0.25 \cdot 49kN \cdot \exp\left(-\frac{2.2m}{2.1m}\right) \cdot \left(\sin\left(\frac{2.2m}{2.1m}\right) - \cos\left(\frac{2.2m}{2.1m}\right)\right)$

16) Dynamic Overload at Joints 🗗

 $\mathbf{F} = \mathrm{F_a} + 0.1188 \cdot \mathrm{V_t} \cdot \sqrt{\mathrm{w}}$

 $\mathbf{ex} \ 311.9522 \mathrm{tf} = 200 \mathrm{tf} + 0.1188 \cdot 149 \mathrm{km/h} \cdot \sqrt{40 \mathrm{tf}}$

Open Calculator 🚰

Open Calculator

17) Isolated Vertical Load given Moment

 $ext{L}_{ ext{Vertical}} = rac{1.1}{0.25 \cdot \exp\left(-rac{ ext{x}}{1}
ight) \cdot \left(\sin\left(rac{ ext{x}}{1}
ight) - \cos\left(rac{ ext{x}}{1}
ight)
ight)}$

Open Calculator 🚰

18) Mass per Wheel given Dynamic Load 🗹

 $\mathbf{w} = \left(rac{\mathrm{F} - \mathrm{F_a}}{0.1188 \cdot \mathrm{V_t}}
ight)^2$

Open Calculator

 $ext{89.32245tf} = \left(rac{311 ext{tf} - 200 ext{tf}}{0.1188 \cdot 149 ext{km/h}}
ight)^2$







19) Static Wheel Load given Dynamic Load 🚰

fx $F_{
m a} = F - 0.1188 \cdot {
m V_t} \cdot \sqrt{
m w}$

Open Calculator 🗗

20) Stress in Rail Foot

 $m S_h = rac{M}{Z_t}$

Open Calculator

21) Stress in Rail Head

ho $ho_{
m h}=rac{
m M}{
m Z_c}$

Open Calculator

Speed Factor

22) Speed Factor

 $extbf{F}_{
m sf} = rac{ ext{V}_{
m t}}{18.2 \cdot \sqrt{ ext{k}}}$

Open Calculator

 $ext{ex} 2.113826 = rac{149 ext{km/h}}{18.2 \cdot \sqrt{15 ext{kgf/m}^2}}$



23) Speed Factor according to German Formula

 $\mathbf{F}_{\mathrm{sf}} = rac{\mathrm{V_t^2}}{30000}$

Open Calculator

 $= 0.740033 = \frac{(149 \text{km/h})^2}{30000}$

24) Speed Factor using German Formula and Speed is above 100kmph

 $\mathbf{F}_{\mathrm{sf}} = \left(rac{4.5\cdot\mathrm{V}_{\mathrm{t}}^2}{10^5}
ight) - \left(rac{1.5\cdot\mathrm{V}_{\mathrm{t}}^3}{10^7}
ight)$

Open Calculator

 $\boxed{ 0.502853 = \left(\frac{4.5 \cdot \left(149 \text{km/h} \right)^2}{10^5} \right) - \left(\frac{1.5 \cdot \left(149 \text{km/h} \right)^3}{10^7} \right) }$

25) Speed given Speed Factor

 $extbf{V}_{ ext{t}} = ext{F}_{ ext{sf}} \cdot \left(18.2 \cdot \sqrt{ ext{k}}
ight)$

Open Calculator 🗗

 $oxed{ex} 140.9766 \mathrm{km/h} = 2 \cdot \left(18.2 \cdot \sqrt{15 \mathrm{kgf/m^2}}
ight)$

26) Speed using German Formula

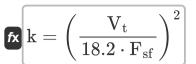
 $extbf{K}V_{
m t}=\sqrt{F_{
m sf}\cdot 30000}$

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 $ext{ex} \ 244.949 ext{km/h} = \sqrt{2 \cdot 30000}$



27) Track Modulus given Speed Factor 🗗



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$$\boxed{16.75598 \mathrm{kgf/m^2} = \left(\frac{149 \mathrm{km/h}}{18.2 \cdot 2}\right)^2}$$



Variables Used

- **D** Diameter of Wheel (Millimeter)
- **F** Dynamic Overload (Ton-Force (Metric))
- Fa Static Load (Ton-Force (Metric))
- F_S Contact Shear Stress (Kilogram-Force per Square Millimeter)
- F_{sf} Speed Factor
- **H** Depth of Wheel Flange (Millimeter)
- I Characteristic Length of Rail (Meter)
- k Track Modulus (Kilogram-Force per Square Meter)
- Characteristic Length (Meter)
- L Lap of Flange (Millimeter)
- Lmax Seat Load (Kilonewton)
- Lvertical Vertical Load on Member (Kilonewton)
- M Bending Moment (Newton Meter)
- R Radius of Curve (Meter)
- R_w Radius of Wheel (Millimeter)
- S Sleeper Spacing (Meter)
- S_h Bending Stress (Pascal)
- V_t Speed of Train (Kilometer per Hour)
- W Unsuspended Mass (Ton-Force (Metric))
- W Wheelbase (Millimeter)
- We Extra Width (Millimeter)
- W_I Wheel Load (Kilonewton)
- X Distance from Load (Meter)
- **z** Section Modulus (Cubic Meter)
- **Z**_C Section Modulus in Compression (Cubic Meter)





• **Z**_t Section Modulus in Tension (Cubic Meter)





Constants, Functions, Measurements used

- Function: cos, cos(Angle)

 Trigonometric cosine function
- Function: exp, exp(Number) Exponential function
- Function: sin, sin(Angle)

 Trigonometric sine function
- Function: sqrt, sqrt(Number) Square root function
- Measurement: Length in Millimeter (mm), Meter (m)

 Length Unit Conversion
- Measurement: Volume in Cubic Meter (m³)

 Volume Unit Conversion
- Measurement: Pressure in Kilogram-Force per Square Millimeter (kgf/mm²),
 Pascal (Pa), Kilogram-Force per Square Meter (kgf/m²)
 Pressure Unit Conversion
- Measurement: Speed in Kilometer per Hour (km/h)
 Speed Unit Conversion
- Measurement: Force in Kilonewton (kN), Ton-Force (Metric) (tf)
 Force Unit Conversion
- Measurement: Moment of Force in Newton Meter (N*m)

 Moment of Force Unit Conversion





Check other formula lists

- Geometric Design of Railway Track Rail Joints, Welding of Rails and Formulas 🚰
- Materials Required per km of Railway Railway Track and Track Stresses track Formulas
- Points and Crossings Formulas
- Sleepers Formulas
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