calculatoratoz.com

unitsconverters.com

Railway Track and Track Stresses Formulas

Calculators! Examples! Conversions!

Bookmark **calculatoratoz.com**, **unitsconverters.com**

Widest Coverage of Calculators and Growing - **30,000+ Calculators!**
Calculate With a Different Unit for Each Variable - **In built Unit Conversion!**
Widest Collection of Measurements and Units - **250+ Measurements!**

Feel free to SHARE this document with your friends!

Please leave your feedback here...

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

Open Calculator

fx $$D = \frac{\left(\frac{L}{2}\right)^2 - H^2}{H}$$

ex $$11.25\text{mm} = \frac{\left(\frac{50\text{mm}}{2}\right)^2 - (20\text{mm})^2}{20\text{mm}}$$

2) Extra Track Width in Curves

Open Calculator

fx $$W_e = \left(W + L^2\right) \cdot \frac{125}{R}$$

ex $$2.180233\text{mm} = \left(3500\text{mm} + (50\text{mm})^2\right) \cdot \frac{125}{344\text{m}}$$

3) Lap of Flange given Diameter of Wheel

Open Calculator

fx $$L = 2 \cdot \left((D \cdot H) + H^2\right)^{0.5}$$

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

4) Lap of Flange given Extra Width of Track

Open Calculator

fx $$L = \sqrt{\left(W_e \cdot \frac{R}{125}\right) - W}$$

ex $$49.9936\text{mm} = \sqrt{\left(2.18\text{mm} \cdot \frac{344\text{m}}{125}\right) - 3500\text{mm}}$$

5) Radius of Curve given Extra Width

Open Calculator

fx $$R = \left(W + L^2\right) \cdot \frac{125}{W_e}$$

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

6) Wheel Base given Extra Width

Open Calculator

fx $$W = \left(W_e \cdot \frac{R}{125}\right) - L^2$$

ex $$3499.36\text{mm} = \left(2.18\text{mm} \cdot \frac{344\text{m}}{125}\right) - (50\text{mm})^2$$

Lateral Forces

7) Characteristic Length given Seat Load on Rail

Open Calculator

fx $$I = W_L \cdot \frac{S}{z \cdot L_{max}}$$

ex $$15.99696\text{m} = 43.47\text{kN} \cdot \frac{2.3\text{m}}{0.0125\text{m}^3 \cdot 500\text{kN}}$$

8) Maximum Contact Shear Stress

Open Calculator

fx $$F_s = 4.13 \cdot \left(\frac{F_a}{R_w} \right)^{\frac{1}{2}}$$

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

9) Maximum Load on Rail Seat

Open Calculator

fx $$L_{max} = W_L \cdot \frac{S}{z \cdot I}$$

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

10) Radius of Wheel given Shear Stress

Open Calculator

fx $$R_w = \left(\frac{4.13}{F_s} \right)^2 \cdot F_a$$

ex $$40.30458\text{mm} = \left(\frac{4.13}{9.2\text{kgf/mm}^2} \right)^2 \cdot 200\text{tf}$$

11) Section Modulus of Rail given Seat Load

Open Calculator

fx $$z = \frac{W_L \cdot S}{I \cdot L_{max}}$$

ex $$0.012498\text{m}^3 = \frac{43.47\text{kN} \cdot 2.3\text{m}}{16\text{m} \cdot 500\text{kN}}$$

12) Sleeper Spacing given Seat Load on Rail

Open Calculator

fx $$S = z \cdot I \cdot \frac{L_{max}}{W_L}$$

ex $$2.300437\text{m} = 0.0125\text{m}^3 \cdot 16\text{m} \cdot \frac{500\text{kN}}{43.47\text{kN}}$$

13) Static Wheel Load given Shear Stress

Open Calculator

fx $$F_a = \left(\frac{F_s}{4.13}\right)^2 \cdot R_w$$

ex $$203.4508\text{tf} = \left(\frac{9.2\text{kgf/mm}^2}{4.13}\right)^2 \cdot 41\text{mm}$$

14) Wheel Load given Seat Load

Open Calculator

fx $$W_L = z \cdot I \cdot \frac{L_{max}}{S}$$

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

Vertical Loads

15) Bending Moment on Rail

Open Calculator

$$M = 0.25 \cdot L_{Vertical} \cdot \exp\left(-\frac{x}{l}\right) \cdot \left(\sin\left(\frac{x}{l}\right) - \cos\left(\frac{x}{l}\right)\right)$$

ex

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

16) Dynamic Overload at Joints

Open Calculator

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

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

17) Isolated Vertical Load given Moment

Open Calculator

$$L_{Vertical} = \frac{M}{0.25 \cdot \exp\left(-\frac{x}{l}\right) \cdot \left(\sin\left(\frac{x}{l}\right) - \cos\left(\frac{x}{l}\right)\right)}$$

ex $$42.926\text{kN} = \frac{1.38\text{N*m}}{0.25 \cdot \exp\left(-\frac{2.2\text{m}}{2.1\text{m}}\right) \cdot \left(\sin\left(\frac{2.2\text{m}}{2.1\text{m}}\right) - \cos\left(\frac{2.2\text{m}}{2.1\text{m}}\right)\right)}$$

18) Mass per Wheel given Dynamic Load

Open Calculator

$$w = \left(\frac{F - F_a}{0.1188 \cdot V_t}\right)^2$$

ex $$39.32245\text{tf} = \left(\frac{311\text{tf} - 200\text{tf}}{0.1188 \cdot 149\text{km/h}}\right)^2$$

19) Static Wheel Load given Dynamic Load

Open Calculator

fx $$F_a = F - 0.1188 \cdot V_t \cdot \sqrt{w}$$

ex $$199.0478\text{tf} = 311\text{tf} - 0.1188 \cdot 149\text{km/h} \cdot \sqrt{40\text{tf}}$$

20) Stress in Rail Foot

Open Calculator

fx $$S_h = \frac{M}{Z_t}$$

ex $$27.05882\text{Pa} = \frac{1.38\text{N*m}}{51\text{m}^3}$$

21) Stress in Rail Head

Open Calculator

fx $$S_h = \frac{M}{Z_c}$$

ex $$26.53846\text{Pa} = \frac{1.38\text{N*m}}{52\text{m}^3}$$

Speed Factor

22) Speed Factor

Open Calculator

fx $$F_{sf} = \frac{V_t}{18.2 \cdot \sqrt{k}}$$

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

23) Speed Factor according to German Formula

Open Calculator

fx $$F_{sf} = \frac{V_t^2}{30000}$$

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

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

Open Calculator

fx $$F_{sf} = \left(\frac{4.5 \cdot V_t^2}{10^5}\right) - \left(\frac{1.5 \cdot V_t^3}{10^7}\right)$$

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

25) Speed given Speed Factor

Open Calculator

fx $$V_t = F_{sf} \cdot \left(18.2 \cdot \sqrt{k}\right)$$

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

26) Speed using German Formula

Open Calculator

fx $$V_t = \sqrt{F_{sf} \cdot 30000}$$

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

27) Track Modulus given Speed Factor

Open Calculator

fx $$k = \left(\frac{V_t}{18.2 \cdot F_{sf}} \right)^2$$

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

Variables Used

- **D** Diameter of Wheel *(Millimeter)*
- **F** Dynamic Overload *(Ton-Force (Metric))*
- F_a 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)*
- **l** Characteristic Length of Rail *(Meter)*
- **k** Track Modulus *(Kilogram-Force per Square Meter)*
- **l** Characteristic Length *(Meter)*
- **L** Lap of Flange *(Millimeter)*
- L_{max} Seat Load *(Kilonewton)*
- $L_{Vertical}$ 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)*
- W_e Extra Width *(Millimeter)*
- W_L 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 (m^3)
  Volume Unit Conversion
- Measurement: **Pressure** in Kilogram-Force per Square Millimeter (kgf/mm^2), Pascal (Pa), Kilogram-Force per Square Meter (kgf/m^2)
  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 Formulas
- Materials Required per km of Railway track Formulas
- Points and Crossings Formulas
- Rail Joints, Welding of Rails and Sleepers Formulas
- Railway Track and Track Stresses Formulas
- Traction and Tractive Resistances Formulas

Feel free to SHARE this document with your friends!

PDF Available in

English Spanish French German Russian Italian Portuguese Polish Dutch

10/5/2023 | 2:44:11 PM UTC *Please leave your feedback here...*