



Stresses Due to External Loads Formulas

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Examples!

Conversions!

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List of 19 Stresses Due to External Loads Formulas

Stresses Due to External Loads

1) Average Load on Pipe due to Wheel Load



Open Calculator

$$= \frac{40.95 \text{N/m} = \frac{2.73 \cdot 10.00 \cdot 75.375 \text{N}}{50.25 \text{m}} }{$$

2) Compressive End Fiber Stress at Horizontal Diameter

$$\mathbf{K} = \left(rac{3 \cdot \mathbf{w}^{'} \cdot \mathbf{d}_{\mathrm{cm}}}{8 \cdot \mathbf{t}_{\mathrm{pipe}}^{2}} + rac{\mathbf{w}^{'}}{2 \cdot \mathbf{t}_{\mathrm{pipe}}}
ight)$$

Open Calculator

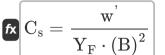
3) Concentrated Wheel Load given Average Load on Pipe

$$P_{wheel} = rac{W_{avg} \cdot L_{eff}}{I_e \cdot C_t}$$

Open Calculator



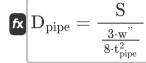
4) Constant which depend upon type of Soil for Load per meter Length of Pipe 🗗



Open Calculator

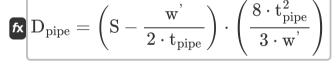
$$= 1.3333333 = \frac{24 \text{kN/m}}{2000 \text{kg/m}^3 \cdot (3\text{m})^2}$$

5) Diameter of Pipe for Maximum End Fiber Stress



Open Calculator

6) Diameter of Pipe given Compressive End Fiber Stress



Open Calculator 🗗

7) Diameter of Pipe given Tensile End Fiber Stress

 $= \left(20.0 \text{kN/m}^2 - \frac{24 \text{kN/m}}{2 \cdot 0.98 \text{m}} \right) \cdot \left(\frac{8 \cdot (0.98 \text{m})^2}{3 \cdot 24 \text{kN/m}} \right)$

$$extbf{D}_{ ext{pipe}} = \left(ext{S} + rac{ ext{w}'}{2 \cdot ext{t}_{ ext{pipe}}}
ight) \cdot \left(rac{8 \cdot ext{t}_{ ext{pipe}}^2}{3 \cdot ext{w}'}
ight)$$

Open Calculator 🗗

$$\boxed{3.440889 m = \left(20.0 kN/m^2 + \frac{24 kN/m}{2 \cdot 0.98 m}\right) \cdot \left(\frac{8 \cdot \left(0.98 m\right)^2}{3 \cdot 24 kN/m}\right)}$$







8) Effective Length of Pipe using Average Load on Pipe

 $L_{eff} = rac{I_e \cdot C_t \cdot P_{wheel}}{W_{avg}}$

Open Calculator

 $= 50.25 \text{m} = \frac{2.73 \cdot 10.00 \cdot 75.375 \text{N}}{40.95 \text{N/m}}$

9) Impact Factor using Average Load on Pipe

 $I_{
m e} = rac{W_{
m avg} \cdot L_{
m eff}}{C_{
m t} \cdot P_{
m wheel}}$

Open Calculator

10) Load Coefficient using Average Load on Pipe

 $ext{C}_{ ext{t}} = rac{ ext{W}_{ ext{avg}} \cdot ext{L}_{ ext{eff}}}{ ext{I}_{ ext{e}} \cdot ext{P}_{ ext{wheel}}}$

Open Calculator

 $= \frac{40.95 \text{N/m} \cdot 50.25 \text{m}}{2.73 \cdot 75.375 \text{N}}$

11) Load per Meter Length of Pipe 🗗

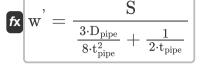
 $\overline{\mathbf{w}}^{'} = \mathrm{C_s} \cdot \mathrm{Y_F} \cdot \mathrm{(B)}^2$

Open Calculator

 $ext{ex} \ 23.94 ext{kN/m} = 1.33 \cdot 2000 ext{kg/m}^3 \cdot (3 ext{m})^2$



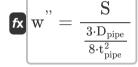
12) Load per Meter Length of Pipe for Compressive End Fiber Stress



Open Calculator

 $23.10737 kN/m = \frac{20.0 kN/m^2}{\frac{3 \cdot 0.91 m}{8 \cdot (0.98 m)^2} + \frac{1}{2 \cdot 0.98 m}}$

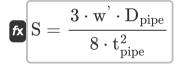
13) Load per Meter Length of Pipe for Maximum End Fiber Stress



Open Calculator 🚰

 $= \frac{56.28718 \text{kN/m}}{\frac{3 \cdot 0.91 \text{m}}{8 \cdot (0.98 \text{m})^2}}$

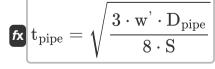
14) Maximum End Fiber Stress on Horizontal Point



Open Calculator 🗗

 $= \frac{8.527697 \text{kN/m}^2 = \frac{3 \cdot 24 \text{kN/m} \cdot 0.91 \text{m}}{8 \cdot (0.98 \text{m})^2} }{8 \cdot (0.98 \text{m})^2}$

15) Thickness of Pipe given Maximum End Fiber Stress



Open Calculator

 $oxed{ex} 0.639922 \mathrm{m} = \sqrt{rac{3 \cdot 24 \mathrm{kN/m} \cdot 0.91 \mathrm{m}}{8 \cdot 20.0 \mathrm{kN/m^2}}}$



16) Total Tension in Pipe using Water Pressure

 $oxed{ ext{T}_{mn} = \left(ext{P}_{water} \cdot ext{A}_{cs}
ight) + \left(rac{ \gamma_{water} \cdot ext{A}_{cs} \cdot \left(ext{V}_{w}
ight)^{2}}{ ext{g}}
ight)}$

Open Calculator

 $\boxed{ 2.36121 \text{MN} = (5.5 \text{N/m}^2 \cdot 13 \text{m}^2) + \left(\frac{9.81 \text{kN/m}^3 \cdot 13 \text{m}^2 \cdot \left(13.47 \text{m/s}\right)^2}{9.8 \text{m/s}^2} \right) }$

17) Total Tension in Pipe with known Head of Water

 $ag{T}_{mn} = ((\gamma_w \cdot H) \cdot A_{cs}) + \left(rac{\gamma_w \cdot A_{cs} \cdot (V_w)^2}{g}
ight).$

Open Calculator

ex

$$4.274089 \text{MN} = \left((9810 \text{N/m}^3 \cdot 15 \text{m}) \cdot 13 \text{m}^2 \right) + \left(\frac{9810 \text{N/m}^3 \cdot 13 \text{m}^2 \cdot \left(13.47 \text{m/s} \right)^2}{9.8 \text{m/s}^2} \right)$$

18) Unit Weight of Backfill Material for Load per Meter Length of Pipe

 $\mathbf{Y}_{\mathrm{F}} = rac{\mathrm{w}^{'}}{\mathrm{C_{s} \cdot (B)}^{2}}$

Open Calculator 🗗

 $ext{ex} \ 2005.013 ext{kg/m}^3 = rac{24 ext{kN/m}}{1.33 \cdot {(3 ext{m})}^2}$



19) Width of Trench for Load per Meter Length of Pipe



Open Calculator 🗗

$$\mathbf{B} = \sqrt{rac{\mathbf{w}^{'}}{\mathbf{C_s} \cdot \mathbf{Y_F}}}$$

$$3.003757 \mathrm{m} = \sqrt{rac{24 \mathrm{kN/m}}{1.33 \cdot 2000 \mathrm{kg/m^3}}}$$



Variables Used

- A_{cs} Cross-Sectional Area (Square Meter)
- **B** Width of Trench (Meter)
- C_S Coefficient Dependent on Soil in Environmental
- Ct Load Coefficient
- d_{cm} Diameter of Pipe in Centimeter (Meter)
- Dpipe Diameter of Pipe (Meter)
- **g** Acceleration due to Gravity in Environment (Meter per Square Second)
- **H** Head of the Liquid (Meter)
- In Impact Factor
- Leff Effective Length of Pipe (Meter)
- Pwater Water Pressure (Newton per Square Meter)
- Pwheel Concentrated Wheel Load (Newton)
- S Extreme Fiber Stress (Kilonewton per Square Meter)
- T_{mn} Total Tension of Pipe in MN (Meganewton)
- tpipe Thickness of Pipe (Meter)
- V_w Flow Velocity of Fluid (Meter per Second)
- Wavq Average Load on Pipe in Newton per Meter (Newton per Meter)
- w Load on Buried Pipe per Unit Length (Kilonewton per Meter)
- w Load per Meter Length of Pipe (Kilonewton per Meter)
- YF Unit Weight of Fill (Kilogram per Cubic Meter)
- Yw Unit Weight of Liquid (Newton per Cubic Meter)
- Ywater Unit Weight of Water in KN per Cubic Meter (Kilonewton per Cubic Meter)





Constants, Functions, Measurements used

• 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.

• Measurement: Length in Meter (m)

Length Unit Conversion

• Measurement: Area in Square Meter (m²)

Area Unit Conversion

• Measurement: Pressure in Newton per Square Meter (N/m²)

Pressure Unit Conversion

• Measurement: Speed in Meter per Second (m/s)

Speed Unit Conversion

• Measurement: Acceleration in Meter per Square Second (m/s²)

Acceleration Unit Conversion

• Measurement: Force in Newton (N), Meganewton (MN)

Force Unit Conversion

 Measurement: Surface Tension in Newton per Meter (N/m), Kilonewton per Meter (kN/m)

Surface Tension Unit Conversion

• Measurement: Density in Kilogram per Cubic Meter (kg/m³)

Density Unit Conversion

 Measurement: Specific Weight in Kilonewton per Cubic Meter (kN/m³), Newton per Cubic Meter (N/m³)

Specific Weight Unit Conversion

• Measurement: Stress in Kilonewton per Square Meter (kN/m²)

Stress Unit Conversion





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- Internal Water Pressure Formulas Stresses Due to External Loads
- Stresses at Bends Formulas
- Formulas 🚰

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