

Important Stresses Due to External Loads Formulas PDF



Formulas Examples with Units

List of 19 Important Stresses Due to External Loads Formulas

1) Average Load on Pipe due to Wheel Load Formula

Formula

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

Example with Units

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

Evaluate Formula 

2) Compressive End Fiber Stress at Horizontal Diameter Formula

Formula

$$S = \left(\frac{3 \cdot w' \cdot d_{cm}^2}{8 \cdot t_{pipe}} + \frac{w'}{2 \cdot t_{pipe}} \right)$$

Example with Units

$$20.6789 \text{ kN/m}^2 = \left(\frac{3 \cdot 24 \text{ kN/m} \cdot 0.90 \text{ m}^2}{8 \cdot 0.98 \text{ m}} + \frac{24 \text{ kN/m}}{2 \cdot 0.98 \text{ m}} \right)$$

Evaluate Formula 

3) Concentrated Wheel Load given Average Load on Pipe Formula

Formula

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

Example with Units

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

Evaluate Formula 

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

Formula

$$C_s = \frac{w'}{Y_F \cdot (B)^2}$$

Example with Units

$$1.3333 = \frac{24 \text{ kN/m}}{2000 \text{ kg/m}^3 \cdot (3 \text{ m})^2}$$

Evaluate Formula 

5) Diameter of Pipe for Maximum End Fiber Stress Formula

Formula

$$D_{pipe} = \frac{S}{\frac{3 \cdot w'}{8 \cdot t_{pipe}^2}}$$

Example with Units

$$2.1342 \text{ m} = \frac{20.0 \text{ kN/m}^2}{\frac{3 \cdot 24 \text{ kN/m}}{8 \cdot 0.98 \text{ m}^2}}$$

Evaluate Formula 



6) Diameter of Pipe given Compressive End Fiber Stress Formula

Formula

$$D_{\text{pipe}} = \left(S - \frac{w'}{2 \cdot t_{\text{pipe}}} \right) \cdot \left(\frac{8 \cdot t_{\text{pipe}}^2}{3 \cdot w'} \right)$$

Evaluate Formula 

Example with Units

$$0.8276 \text{ m} = \left(20.0 \text{ kN/m}^2 - \frac{24 \text{ kN/m}}{2 \cdot 0.98 \text{ m}} \right) \cdot \left(\frac{8 \cdot 0.98 \text{ m}^2}{3 \cdot 24 \text{ kN/m}} \right)$$

7) Diameter of Pipe given Tensile End Fiber Stress Formula

Formula

$$D_{\text{pipe}} = \left(S + \frac{w'}{2 \cdot t_{\text{pipe}}} \right) \cdot \left(\frac{8 \cdot t_{\text{pipe}}^2}{3 \cdot w'} \right)$$

Evaluate Formula 

Example with Units

$$3.4409 \text{ m} = \left(20.0 \text{ kN/m}^2 + \frac{24 \text{ kN/m}}{2 \cdot 0.98 \text{ m}} \right) \cdot \left(\frac{8 \cdot 0.98 \text{ m}^2}{3 \cdot 24 \text{ kN/m}} \right)$$

8) Effective Length of Pipe using Average Load on Pipe Formula

Formula

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

Example with Units

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

Evaluate Formula 

9) Impact Factor using Average Load on Pipe Formula

Formula

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

Example with Units

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

Evaluate Formula 

10) Load Coefficient using Average Load on Pipe Formula

Formula

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

Example with Units

$$10 = \frac{40.95 \text{ N/m} \cdot 50.25 \text{ m}}{2.73 \cdot 75.375 \text{ N}}$$

Evaluate Formula 

11) Load per Meter Length of Pipe Formula

Formula

$$w' = C_s \cdot Y_F \cdot (B)^2$$

Example with Units

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

Evaluate Formula 



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

Formula

$$w' = \frac{S}{\frac{3 \cdot D_{\text{pipe}}}{8 \cdot t_{\text{pipe}}^2} + \frac{1}{2 \cdot t_{\text{pipe}}}}$$

Example with Units

$$23.1074 \text{ kN/m} = \frac{20.0 \text{ kN/m}^2}{\frac{3 \cdot 0.91 \text{ m}}{8 \cdot 0.98 \text{ m}^2} + \frac{1}{2 \cdot 0.98 \text{ m}}}$$

Evaluate Formula 

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

Formula

$$w' = \frac{S}{\frac{3 \cdot D_{\text{pipe}}}{8 \cdot t_{\text{pipe}}^2}}$$

Example with Units

$$56.2872 \text{ kN/m} = \frac{20.0 \text{ kN/m}^2}{\frac{3 \cdot 0.91 \text{ m}}{8 \cdot 0.98 \text{ m}^2}}$$

Evaluate Formula 

14) Maximum End Fiber Stress on Horizontal Point Formula

Formula

$$S = \frac{3 \cdot w' \cdot D_{\text{pipe}}}{8 \cdot t_{\text{pipe}}^2}$$

Example with Units

$$8.5277 \text{ kN/m}^2 = \frac{3 \cdot 24 \text{ kN/m} \cdot 0.91 \text{ m}}{8 \cdot 0.98 \text{ m}^2}$$

Evaluate Formula 

15) Thickness of Pipe given Maximum End Fiber Stress Formula

Formula

$$t_{\text{pipe}} = \sqrt{\frac{3 \cdot w' \cdot D_{\text{pipe}}}{8 \cdot S}}$$

Example with Units

$$0.6399 \text{ m} = \sqrt{\frac{3 \cdot 24 \text{ kN/m} \cdot 0.91 \text{ m}}{8 \cdot 20.0 \text{ kN/m}^2}}$$

Evaluate Formula 

16) Total Tension in Pipe using Water Pressure Formula

Formula

$$T_{\text{mn}} = (P_{\text{water}} \cdot A_{\text{cs}}) + \left(\frac{\gamma_{\text{water}} \cdot A_{\text{cs}} \cdot (V_w)^2}{g} \right)$$

Example with Units

$$2.3612 \text{ MN} = (5.5 \text{ N/m}^2 \cdot 13 \text{ m}^2) + \left(\frac{9.81 \text{ kN/m}^3 \cdot 13 \text{ m}^2 \cdot (13.47 \text{ m/s})^2}{9.8 \text{ m/s}^2} \right)$$

Evaluate Formula 



17) Total Tension in Pipe with known Head of Water Formula

Formula

Evaluate Formula 

$$T_{mn} = \left(\left(\gamma_w \cdot H \right) \cdot A_{cs} \right) + \left(\frac{\gamma_w \cdot A_{cs} \cdot \left(V_w \right)^2}{g} \right)$$

Example with Units

$$4.2741 \text{ MN} = \left(\left(9810 \text{ N/m}^3 \cdot 15 \text{ m} \right) \cdot 13 \text{ m}^2 \right) + \left(\frac{9810 \text{ N/m}^3 \cdot 13 \text{ m}^2 \cdot \left(13.47 \text{ m/s} \right)^2}{9.8 \text{ m/s}^2} \right)$$

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

Formula

Example with Units

Evaluate Formula 

$$Y_F = \frac{w'}{C_s \cdot (B)^2}$$

$$2005.0125 \text{ kg/m}^3 = \frac{24 \text{ kN/m}}{1.33 \cdot (3 \text{ m})^2}$$

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

Formula

Example with Units

Evaluate Formula 

$$B = \sqrt{\frac{w'}{C_s \cdot Y_F}}$$

$$3.0038 \text{ m} = \sqrt{\frac{24 \text{ kN/m}}{1.33 \cdot 2000 \text{ kg/m}^3}}$$



Variables used in list of Stresses Due to External Loads Formulas above

- **A_{cs}** Cross-Sectional Area (Square Meter)
- **B** Width of Trench (Meter)
- **C_s** Coefficient Dependent on Soil in Environmental
- **C_t** Load Coefficient
- **d_{cm}** Diameter of Pipe in Centimeter (Meter)
- **D_{pipe}** Diameter of Pipe (Meter)
- **g** Acceleration due to Gravity in Environment (Meter per Square Second)
- **H** Head of the Liquid (Meter)
- **I_e** Impact Factor
- **L_{eff}** Effective Length of Pipe (Meter)
- **P_{water}** Water Pressure (Newton per Square Meter)
- **P_{wheel}** Concentrated Wheel Load (Newton)
- **S** Extreme Fiber Stress (Kilonewton per Square Meter)
- **T_{mn}** Total Tension of Pipe in MN (Meganewton)
- **t_{pipe}** Thickness of Pipe (Meter)
- **V_w** Flow Velocity of Fluid (Meter per Second)
- **W_{avg}** 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)
- **Y_F** Unit Weight of Fill (Kilogram per Cubic Meter)
- **Y_w** Unit Weight of Liquid (Newton per Cubic Meter)
- **Y_{water}** Unit Weight of Water in KN per Cubic Meter (Kilonewton per Cubic Meter)

Constants, Functions, Measurements used in list of Stresses Due to External Loads Formulas above

- **Functions:** **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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