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Stresses Due to External Loads Formulas

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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

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

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

2) Compressive End Fiber Stress at Horizontal Diameter

Open Calculator

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

$$20.67888\text{kN/m}^2 = \left(\frac{3 \cdot 24\text{kN/m} \cdot 0.90\text{m}}{8 \cdot (0.98\text{m})^2} + \frac{24\text{kN/m}}{2 \cdot 0.98\text{m}} \right)$$

3) Concentrated Wheel Load given Average Load on Pipe

Open Calculator

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

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

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

Open Calculator

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

$$1.333333 = \frac{24\text{kN/m}}{2000\text{kg/m}^3 \cdot (3\text{m})^2}$$

5) Diameter of Pipe for Maximum End Fiber Stress

Open Calculator

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

$$0.910116\text{m} = \frac{20.0\text{kN/m}^2}{\frac{3 \cdot 56.28\text{kN/m}}{8 \cdot (0.98\text{m})^2}}$$

6) Diameter of Pipe given Compressive End Fiber Stress

Open Calculator

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

$$0.827556\text{m} = \left(20.0\text{kN/m}^2 - \frac{24\text{kN/m}}{2 \cdot 0.98\text{m}}\right) \cdot \left(\frac{8 \cdot (0.98\text{m})^2}{3 \cdot 24\text{kN/m}}\right)$$

7) Diameter of Pipe given Tensile End Fiber Stress

Open Calculator

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

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

8) Effective Length of Pipe using Average Load on Pipe

Open Calculator

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

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

9) Impact Factor using Average Load on Pipe

Open Calculator

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

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

10) Load Coefficient using Average Load on Pipe

Open Calculator

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

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

11) Load per Meter Length of Pipe

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

$$56.28718\text{kN/m} = \frac{20.0\text{kN/m}^2}{\frac{3 \cdot 0.91\text{m}}{8 \cdot (0.98\text{m})^2}}$$

14) Maximum End Fiber Stress on Horizontal Point

Open Calculator

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

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

15) Thickness of Pipe given Maximum End Fiber Stress

Open Calculator

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

$$0.639922\text{m} = \sqrt{\frac{3 \cdot 24\text{kN/m} \cdot 0.91\text{m}}{8 \cdot 20.0\text{kN/m}^2}}$$

16) Total Tension in Pipe using Water Pressure

Open Calculator

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

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

17) Total Tension in Pipe with known Head of Water

Open Calculator

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

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

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

Open Calculator

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

$$2005.013\text{kg/m}^3 = \frac{24\text{kN/m}}{1.33 \cdot (3\text{m})^2}$$

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

Open Calculator

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

ex $$3.003757\text{m} = \sqrt{\frac{24\text{kN/m}}{1.33 \cdot 2000\text{kg/m}^3}}$$

Variables Used

- A_{cs} Cross-Sectional Area *(Square Meter)*
- B Width of Trench *(Meter)*
- C_s Coefficient Dependent on Soil in Environmental
- 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)*
- γ_w Unit Weight of Liquid *(Newton per Cubic Meter)*
- γ_{water} 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

Check other formula lists

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

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