Important Analysis of Bar Formulas PDF

Formulas
Examples
with Units

List of 15
Important Analysis of Bar Formulas

1) Elongation of Bar due its Own Weight Formulas

1.1) Bar's total elongation if weight given per unit volume of bar Formula

Evaluate Formula

Formula

$$\delta L = \frac{w \cdot \left(L_{bar}^{2} \right)}{2 \cdot E_{bar}}$$

Example with Units

$$3E\text{-}5\,\text{mm} = \frac{10.0\,\text{N/m}^3 \cdot \left(256.66\,\text{mm}^{2} \right)}{2 \cdot 11\,\text{MPa}}$$

1.2) Elongation of element Formula

Evaluate Formula

Formula

$$\Delta L_{Bar} = \frac{w \cdot \left(L_{bar}^{2} \right)}{2 \cdot E}$$

Example with Units

$$0.0143\,\text{mm} = \frac{10.0\,\text{N/m}^3 \cdot \left(256.66\,\text{mm}^{2} \right)}{2 \cdot 0.023\,\text{MPa}}$$

1.3) Length of Bar given Total Elongation of Bar Formula

Evaluate Formula

Formula

$$L_{bar} = \frac{\delta L \cdot 2 \cdot E_{bar}}{\rho_A}$$

Example with Units

$$256.6667\,\text{mm} = \frac{70.0\,\text{mm} \cdot 2 \cdot 11\,\text{MPa}}{6\,\text{MPa}}$$

1.4) Length of Bar using Total Elongation and Weight per unit volume of bar Formula

Evaluate Formula

Formula

$$L_{bar} = \sqrt{\frac{\delta L \cdot 2 \cdot E_{bar}}{w}}$$

Example with Units

$$392428.3374\,\text{mm} = \sqrt{\frac{70.0\,\text{mm} \cdot 2 \cdot 11\,\text{MPa}}{10.0\,\text{N/m}^3}}$$

1.5) Modulus of Elasticity given Total Elongation of Bar Formula

Evaluate Formula

Formula

$$E_{bar} = \frac{\rho_A \cdot L_{bar}}{2 \cdot \delta L}$$

Example with Units

$$10.9997\,\text{MPa} = \frac{6\,\text{MPa} \cdot 256.66\,\text{mm}}{2 \cdot 70.0\,\text{mm}}$$

1.6) Strain in Element Formula

Evaluate Formula

Formula

$$\varepsilon = \frac{w \cdot L_{bar}}{E}$$

Example with Units

$$0.0001 = \frac{10.0\,\text{N/m}^3 \cdot 256.66\,\text{mm}}{0.023\,\text{MPa}}$$

1.7) Stress on element of rod Formula

Evaluate Formula

Formula

$$\sigma = w \cdot L_{bar}$$

Example with Units

$$2.6\text{E-}6\,\text{MPa} = 10.0\,\text{N/m}^3 \cdot 256.66\,\text{mm}$$

1.8) Total elongation of bar Formula

Evaluate Formula

Formula

$$\delta L = \frac{\rho_A \cdot L_{bar}}{2 \cdot E_{bar}}$$

Example with Units

$$69.9982\,\text{mm} = \frac{6\,\text{MPa} \cdot 256.66\,\text{mm}}{2 \cdot 11\,\text{MPa}}$$

1.9) Weight of bar for length x Formula

Evaluate Formula

Formula

$$W = w \cdot A \cdot L_{bar}$$

Example with Units

$$0.1643\,\text{kg} = 10.0\,\text{N/m}^3 \cdot 64000\,\text{mm}^2 \cdot 256.66\,\text{mm}$$

1.10) Weight of Bar given Total Elongation of Bar Formula

Evaluate Formula

Formula

$$W_{load} = \frac{\delta L \cdot 2 \cdot E_{bar} \cdot A}{L_{bar}}$$

Example with Units

$$384009.9743\,\text{N} = \frac{70.0\,\text{mm} \cdot 2 \cdot 11\,\text{MPa} \cdot 64000\,\text{mm}^2}{256.66\,\text{mm}}$$

2) Strain in Bar Formulas

2.1) Area of lower end of bar Formula

Evaluate Formula

Formula

$$A_2 = \frac{A_1}{e^{w \cdot \frac{L_{bar}}{\sigma}}}$$

Example with Units

$$3000.0003\,\text{mm}^2 = \frac{3000.642\,\text{mm}^2}{e^{10.0\,\text{N/m}^3 \cdot \frac{256.66\,\text{mm}}{0.012\,\text{MPa}}}}$$

2.2) Area of upper end of bar Formula

Evaluate Formula

Formula

$$A_1 = A_2 \cdot e^{w \cdot \frac{L_{bar}}{\sigma}}$$

Example with Units

$$3000.6417\,\text{mm}^2 = 3000\,\text{mm}^2 \cdot e^{10.0\,\text{N/m}^3 \cdot \frac{256.66\,\text{mm}}{0.012\,\text{MPa}}}$$

2.3) Change in length of Tapered Bar Formula

Evaluate Formula

Formula

$$\Delta L = \left(F_a \cdot \frac{l}{t \cdot E \cdot \left(L^{Right} - L_{Left} \right)} \right) \cdot \frac{\ln\left(\frac{L^{Right}}{L_{Left}} \right)}{1000000}$$

Example with Units

$$0.0084\,\text{mm} = \left(2500\,\text{N} \cdot \frac{7800\,\text{mm}}{1200\,\text{mm} \cdot 0.023\,\text{MPa} \cdot \left(70\,\text{mm} - 100\,\text{mm} \right)} \right) \cdot \frac{\ln\left(\frac{70\,\text{mm}}{100\,\text{mm}} \right)}{1000000}$$

2.4) Elongation of bar given applied tensile load, area and length Formula

Evaluate Formula

Formula

$$\Delta = P \cdot \frac{L_0}{A_{cs} \cdot E}$$

Example with Units

$$339.6739\,\text{mm} = 10\,\text{N} \cdot \frac{5000\,\text{mm}}{6400\,\text{mm}^2 \cdot 0.023\,\text{MPa}}$$

2.5) Longitudinal Strain using Poisson's Ratio Formula

Evaluate Formula

Formula

$$\varepsilon_{ln} = -\left(\frac{\varepsilon_L}{\nu} \right)$$

Example

$$0.0667 = -\left(\frac{0.02}{-0.3} \right)$$

Variables used in list of Analysis of Bar Formulas above

- Δ Elongation *(Millimeter)*
- **A** Cross Sectional Area of Bar *(Square Millimeter)*
- A_1 Area of Upper End *(Square Millimeter)*
- A_2 Area of The Lower End *(Square Millimeter)*
- A_{cs} Area of Cross-Section *(Square Millimeter)*
- **E** Young's Modulus Bar *(Megapascal)*
- E_{bar} Modulus of Elasticity Of Bar *(Megapascal)*
- F_a Applied Force *(Newton)*
- **l** Length of Tapered Bar *(Millimeter)*
- L_0 Original Length *(Millimeter)*
- L_{bar} Length of Bar *(Millimeter)*
- L_{Left} Length of Tapered Bar on Left *(Millimeter)*
- L^{Right} Length of Tapered Bar on Right *(Millimeter)*
- **P** Axial Force *(Newton)*
- **t** Thickness *(Millimeter)*
- **w** Weight per unit volume *(Newton per Cubic Meter)*
- **W** Weight *(Kilogram)*
- W_{load} Load *(Newton)*
- δL Total Elongation *(Millimeter)*
- ΔL Change in Length of Tapered Bar *(Millimeter)*
- ΔL_{Bar} Increase in Bar Length *(Millimeter)*
- ε Strain
- ε_L Lateral Strain
- ε_{ln} Longitudinal Strain
- ρ_A Weight by Area *(Megapascal)*
- σ Stress in Bar *(Megapascal)*
- ν Poisson's Ratio

Constants, Functions, Measurements used in list of Analysis of Bar Formulas above

- constant(s): **e**, 2.71828182845904523536028747135266249 *Napier's constant*
- Functions: **ln**, ln(Number) *The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.*
- 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 Millimeter (mm) *Length Unit Conversion*
- Measurement: **Weight** in Kilogram (kg) *Weight Unit Conversion*
- Measurement: **Area** in Square Millimeter (mm²) *Area Unit Conversion*
- Measurement: **Pressure** in Megapascal (MPa) *Pressure Unit Conversion*
- Measurement: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Specific Weight** in Newton per Cubic Meter (N/m³) *Specific Weight Unit Conversion*
- Measurement: **Stress** in Megapascal (MPa) *Stress Unit Conversion*

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