Important Elastic Constants Formulas PDF

Formulas
Examples
with Units

List of 20
Important Elastic Constants Formulas

1) Longitudinal and Lateral Strain Formulas

1.1) Lateral Strain using Poisson's Ratio Formula

Evaluate Formula

Formula

$$\varepsilon_L = -\left(\nu \cdot \varepsilon_{longitudinal}\right)$$

Example

$$-0.06 = -\left(0.3 \cdot 0.2\right)$$

1.2) Longitudinal Strain using Poisson's Ratio Formula

Evaluate Formula

Formula

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

Example

$$0.2 = -\left(\frac{-0.06}{0.3}\right)$$

1.3) Poisson's Ratio Formula

Evaluate Formula

Formula

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

Example

$$0.3 = -\left(\frac{-0.06}{0.2}\right)$$

2) Volumetric Strain Formulas

2.1) Bulk Modulus given Direct Stress Formula

Evaluate Formula

Formula

$$K = \frac{\sigma}{\varepsilon_v}$$

Example with Units

$$180000\,\text{MPa} = \frac{18\,\text{MPa}}{0.0001}$$

2.2) Bulk Modulus using Young's Modulus Formula

Evaluate Formula

Formula

$$K = \frac{E}{3 \cdot \left(1 - 2 \cdot \nu\right)}$$

Example with Units

$$16666.6667\,\text{MPa} = \frac{20000\,\text{MPa}}{3 \cdot \left(1 - 2 \cdot 0.3\right)}$$

2.3) Direct Stress for given Bulk Modulus and Volumetric Strain Formula

Evaluate Formula

Formula

$$\sigma = K \cdot \varepsilon_v$$

Example with Units

$$1.8\,\text{MPa} = 18000\,\text{MPa} \cdot 0.0001$$

2.4) Lateral Strain given Volumetric and Longitudinal Strain Formula

Evaluate Formula

Formula

$$\varepsilon_L = -\frac{\varepsilon_{longitudinal} - \varepsilon_v}{2}$$

Example

$$-0.1 = -\frac{0.2 - 0.0001}{2}$$

2.5) Longitudinal Strain given Volumetric and Lateral Strain Formula

Evaluate Formula

Formula

$$\varepsilon_{longitudinal} = \varepsilon_v - \left(2 \cdot \varepsilon_L\right)$$

Example

$$0.1201 = 0.0001 - \left(2 \cdot -0.06\right)$$

2.6) Longitudinal Strain given Volumetric Strain and Poisson's Ratio Formula

Evaluate Formula

Formula

$$\varepsilon_{longitudinal} = \frac{\varepsilon_v}{1 - 2 \cdot \nu}$$

Example

$$0.0002 = \frac{0.0001}{1 - 2 \cdot 0.3}$$

2.7) Poisson's Ratio given Volumetric Strain and Longitudinal Strain Formula

Evaluate Formula

Formula

$$\nu = \frac{1}{2} \cdot \left(1 - \frac{\varepsilon_v}{\varepsilon_{longitudinal}}\right)$$

Example

$$0.4998 = \frac{1}{2} \cdot \left(1 - \frac{0.0001}{0.2}\right)$$

2.8) Poisson's Ratio using Bulk Modulus and Young's Modulus Formula

Evaluate Formula

Formula

$$\nu = \frac{3 \cdot K - E}{6 \cdot K}$$

Example with Units

$$0.3148 = \frac{3 \cdot 18000\,\text{MPa} - 20000\,\text{MPa}}{6 \cdot 18000\,\text{MPa}}$$

2.9) Volumetric Strain given Bulk Modulus Formula

Evaluate Formula

Formula

$$\varepsilon_v = \frac{\sigma}{K}$$

Example with Units

$$0.001 = \frac{18\,\text{MPa}}{18000\,\text{MPa}}$$

2.10) Volumetric Strain given Change in Length Formula

Evaluate Formula

Formula

$$\varepsilon_v = \left(\frac{\Delta l}{l}\right) \cdot \left(1 - 2 \cdot \nu\right)$$

Example with Units

$$0.0004 = \left(\frac{0.0025\,\text{m}}{2.5\,\text{m}}\right) \cdot \left(1 - 2 \cdot 0.3\right)$$

2.11) Volumetric Strain given Change in Length, Breadth and Width Formula

Evaluate Formula

Formula

$$\varepsilon_v = \frac{\Delta l}{l} + \frac{\Delta b}{b} + \frac{\Delta d}{d}$$

Example with Units

$$0.0203 = \frac{0.0025\,\text{m}}{2.5\,\text{m}} + \frac{0.014\,\text{m}}{1.5\,\text{m}} + \frac{0.012\,\text{m}}{1.2\,\text{m}}$$

2.12) Volumetric Strain given Longitudinal and Lateral Strain Formula

Evaluate Formula

Formula

$$\varepsilon_v = \varepsilon_{longitudinal} + 2 \cdot \varepsilon_L$$

Example

$$0.08 = 0.2 + 2 \cdot -0.06$$

2.13) Volumetric Strain of Cylindrical Rod Formula

Evaluate Formula

Formula

$$\varepsilon_v = \varepsilon_{longitudinal} - 2 \cdot \left(\varepsilon_L \right)$$

Example

$$0.32 = 0.2 - 2 \cdot \left(-0.06 \right)$$

2.14) Volumetric Strain of Cylindrical Rod using Poisson's Ratio Formula

Evaluate Formula

Formula

$$\varepsilon_v = \varepsilon_{longitudinal} \cdot \left(1 - 2 \cdot \nu \right)$$

Example

$$0.08 = 0.2 \cdot \left(1 - 2 \cdot 0.3 \right)$$

2.15) Volumetric Strain using Young's Modulus and Poisson's Ratio Formula

Evaluate Formula

Formula

$$\varepsilon_v = \frac{3 \cdot \sigma_t \cdot \left(1 - 2 \cdot \nu \right)}{E}$$

Example with Units

$$0.001 = \frac{3 \cdot 16.6\,\text{MPa} \cdot \left(1 - 2 \cdot 0.3 \right)}{20000\,\text{MPa}}$$

2.16) Young's Modulus using Bulk Modulus Formula

Evaluate Formula

Formula

$$E = 3 \cdot K \cdot \left(1 - 2 \cdot \nu \right)$$

Example with Units

$$21600\,\text{MPa} = 3 \cdot 18000\,\text{MPa} \cdot \left(1 - 2 \cdot 0.3 \right)$$

2.17) Young's Modulus using Poisson's Ratio Formula

Evaluate Formula

Formula

$$E = \frac{3 \cdot \sigma_t \cdot \left(1 - 2 \cdot \nu \right)}{\varepsilon_v}$$

Example with Units

$$199200\,\text{MPa} = \frac{3 \cdot 16.6\,\text{MPa} \cdot \left(1 - 2 \cdot 0.3 \right)}{0.0001}$$

Variables used in list of Elastic Constants Formulas above

- **b** Breadth of Bar *(Meter)*
- **d** Depth of Bar *(Meter)*
- **E** Young's Modulus *(Megapascal)*
- **K** Bulk Modulus *(Megapascal)*
- **l** Length of Section *(Meter)*
- **Δb** Change in Breadth *(Meter)*
- **Δd** Change in Depth *(Meter)*
- **Δl** Change in Length *(Meter)*
- ε_L Lateral Strain
- $\varepsilon_{longitudinal}$ Longitudinal Strain
- ε_v Volumetric Strain
- σ Direct Stress *(Megapascal)*
- σ_t Tensile Stress *(Megapascal)*
- ν Poisson's Ratio

Constants, Functions, Measurements used in list of Elastic Constants Formulas above

- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Stress** in Megapascal (MPa)
  Stress Unit Conversion

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