

Important Relationship between Stress and Strain Formulas PDF



Formulas Examples with Units

List of 19 Important Relationship between Stress and Strain Formulas

1) Factor of Safety Formula ↻

Formula

$$F.O.S = \frac{U}{P}$$

Example with Units

$$4.0833 = \frac{49 \text{ MPa}}{12 \text{ MPa}}$$

Evaluate Formula ↻

2) Margin of Safety Formula ↻

Formula

$$M.O.S. = F.O.S - 1$$

Example

$$3 = 4 - 1$$

Evaluate Formula ↻

3) Modulus of Elasticity given Compressive Stress Formula ↻

Formula

$$E = \left(\frac{\sigma_c}{\epsilon_{\text{compressive}}} \right)$$

Example with Units

$$64 \text{ MPa} = \left(\frac{6.4 \text{ MPa}}{0.1} \right)$$

Evaluate Formula ↻

4) Modulus of Elasticity given Normal Stress Formula ↻

Formula

$$E = \frac{\sigma_n}{\epsilon_{\text{component}}}$$

Example with Units

$$96 \text{ MPa} = \frac{48 \text{ MPa}}{0.5}$$

Evaluate Formula ↻

5) Modulus of Elasticity given Tensile Stress Formula ↻

Formula

$$E = \left(\frac{\sigma_t}{\epsilon_{\text{tensile}}} \right)$$

Example with Units

$$5.65 \text{ MPa} = \left(\frac{3.39 \text{ MPa}}{0.6} \right)$$

Evaluate Formula ↻

6) Modulus of Rigidity given Shear Stress Formula ↻

Formula

$$G = \left(\frac{\tau}{\eta} \right)$$

Example with Units

$$2.8571 \text{ MPa} = \left(\frac{5 \text{ MPa}}{1.75} \right)$$

Evaluate Formula ↻



7) Strain Formulas

7.1) Compressive Strain given Compressive Stress Formula

Formula

$$\epsilon_{\text{compressive}} = \left(\frac{\sigma_c}{E} \right)$$

Example with Units

$$0.8 = \left(\frac{6.4 \text{ MPa}}{8 \text{ MPa}} \right)$$

Evaluate Formula 

7.2) Lateral Strain given Decrease in Breadth Formula

Formula

$$\epsilon_L = \frac{\Delta b}{b}$$

Example with Units

$$0.23 = \frac{46 \text{ mm}}{200 \text{ mm}}$$

Evaluate Formula 

7.3) Lateral Strain given Decrease in Depth Formula

Formula

$$\epsilon_L = \frac{\Delta d}{d}$$

Example with Units

$$0.43 = \frac{43 \text{ mm}}{100 \text{ mm}}$$

Evaluate Formula 

7.4) Lateral Strain using Poisson's Ratio Formula

Formula

$$\epsilon_L = - \left(\nu \cdot \epsilon_{\text{longitudinal}} \right)$$

Example

$$-0.0186 = - \left(0.3 \cdot 0.062 \right)$$

Evaluate Formula 

7.5) Longitudinal Strain Formula

Formula

$$\epsilon_{\text{longitudinal}} = \frac{\Delta L}{L_0}$$

Example with Units

$$0.22 = \frac{1100 \text{ mm}}{5000 \text{ mm}}$$

Evaluate Formula 

7.6) Shear Strain if Modulus of Rigidity and Shear Stress Formula

Formula

$$\eta = \frac{\tau}{G}$$

Example with Units

$$0.1389 = \frac{5 \text{ MPa}}{36 \text{ MPa}}$$

Evaluate Formula 

7.7) Tensile Strain given Modulus of Elasticity Formula

Formula

$$\epsilon_{\text{tensile}} = \left(\frac{\sigma_t}{E} \right)$$

Example with Units

$$0.4238 = \left(\frac{3.39 \text{ MPa}}{8 \text{ MPa}} \right)$$

Evaluate Formula 



8) Stress Formulas

8.1) Compressive Stress given Compressive Strain Formula

Formula

$$\sigma_c = (E \cdot \epsilon_{\text{compressive}})$$

Example with Units

$$0.8 \text{ MPa} = (8 \text{ MPa} \cdot 0.1)$$

Evaluate Formula 

8.2) Normal Stress given Modulus of Elasticity Formula

Formula

$$\sigma_n = \epsilon_{\text{component}} \cdot E$$

Example with Units

$$4 \text{ MPa} = 0.5 \cdot 8 \text{ MPa}$$

Evaluate Formula 

8.3) Permissible Stress using Factor of Safety Formula

Formula

$$P = \frac{U}{\text{F.O.S}}$$

Example with Units

$$12.25 \text{ MPa} = \frac{49 \text{ MPa}}{4}$$

Evaluate Formula 

8.4) Shear Stress given Shear Strain Formula

Formula

$$\tau = (G \cdot \eta)$$

Example with Units

$$63 \text{ MPa} = (36 \text{ MPa} \cdot 1.75)$$

Evaluate Formula 

8.5) Tensile Stress given Modulus of Elasticity Formula

Formula

$$\sigma_t = (E \cdot \epsilon_{\text{tensile}})$$

Example with Units

$$4.8 \text{ MPa} = (8 \text{ MPa} \cdot 0.6)$$

Evaluate Formula 

8.6) Ultimate Stress using Factor of Safety Formula

Formula

$$U = \text{F.O.S} \cdot P$$

Example with Units

$$48 \text{ MPa} = 4 \cdot 12 \text{ MPa}$$

Evaluate Formula 



Variables used in list of Relationship between Stress and Strain Formulas above

- **b** Breadth of Component (Millimeter)
- **d** Depth of Component (Millimeter)
- **E** Modulus of Elasticity (Megapascal)
- **F.O.S** Factor of Safety
- **G** Modulus of Rigidity (Megapascal)
- **L₀** Original Length (Millimeter)
- **M.O.S.** Margin of Safety
- **P** Permissible Stress (Megapascal)
- **U** Ultimate Stress (Megapascal)
- **Δb** Decrease in Breadth (Millimeter)
- **Δd** Decrease in Depth (Millimeter)
- **ΔL** Change in Length of Component (Millimeter)
- **ε_{component}** Strain in Component
- **ε_{compressive}** Compressive Strain
- **ε_L** Lateral Strain
- **ε_{longitudinal}** Longitudinal Strain
- **ε_{tensile}** Tensile Strain
- **σ_c** Compressive Stress (Megapascal)
- **σ_n** Normal Stress (Megapascal)
- **σ_t** Tensile Stress (Megapascal)
- **ν** Poisson's Ratio
- **η** Shear Strain
- **τ** Shear Stress (Megapascal)

Constants, Functions, Measurements used in list of Relationship between Stress and Strain Formulas above

- **Measurement: Length** in Millimeter (mm)
Length Unit Conversion 
- **Measurement: Pressure** in Megapascal (MPa)
Pressure Unit Conversion 
- **Measurement: Stress** in Megapascal (MPa)
Stress Unit Conversion 



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