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Relationship between Stress and Strain Formulas

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List of 19 Relationship between Stress and Strain Formulas

Relationship between Stress and Strain

1) Factor of Safety

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

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$\text{ex } 4.083333 = \frac{49\text{MPa}}{12\text{MPa}}$$

2) Margin of Safety

$$\text{fx } \text{M.O.S.} = \text{F.O.S} - 1$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$\text{ex } 3 = 4 - 1$$

3) Modulus of Elasticity given Compressive Stress

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

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

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



4) Modulus of Elasticity given Normal Stress

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

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

5) Modulus of Elasticity given Tensile Stress

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

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

6) Modulus of Rigidity given Shear Stress

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 2.857143\text{MPa} = \left(\frac{5\text{MPa}}{1.75} \right)$$



Strain

7) Compressive Strain given Compressive Stress

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

[Open Calculator !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5_img.jpg\)](#)

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

8) Lateral Strain given Decrease in Breadth

$$\text{fx } \epsilon_d = \frac{\Delta b}{b}$$

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a_img.jpg\)](#)

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

9) Lateral Strain given Decrease in Depth

$$\text{fx } \epsilon_d = \frac{\Delta d}{d}$$

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a_img.jpg\)](#)

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

10) Lateral Strain using Poisson's Ratio

$$\text{fx } \epsilon_d = -(\nu \cdot \epsilon_{\text{longitudinal}})$$

[Open Calculator !\[\]\(c1168d6a8b365d11e842ece304635fa7_img.jpg\)](#)

$$\text{ex } -0.06 = -(0.3 \cdot 0.2)$$



11) Longitudinal Strain

$$\text{fx } \epsilon_{\text{longitudinal}} = \frac{\Delta L}{l_0}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

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

12) Shear Strain if Modulus of Rigidity and Shear Stress

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } 0.138889 = \frac{5\text{MPa}}{36\text{MPa}}$$

13) Tensile Strain given Modulus of Elasticity

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$\text{ex } 0.42375 = \left(\frac{3.39\text{MPa}}{8\text{MPa}} \right)$$

Stress

14) Compressive Stress given Compressive Strain

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

[Open Calculator !\[\]\(e50091943b385fe16d3277389202856f_img.jpg\)](#)

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



15) Normal Stress given Modulus of Elasticity 

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0_img.jpg\)](#)

$$ex \quad 4MPa = 0.5 \cdot 8MPa$$

16) Permissible Stress using Factor of Safety 

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

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5_img.jpg\)](#)

$$ex \quad 12.25MPa = \frac{49MPa}{4}$$

17) Shear Stress given Shear Strain 

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

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60_img.jpg\)](#)


$$ex \quad 63MPa = (36MPa \cdot 1.75)$$

18) Tensile Stress given Modulus of Elasticity 

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

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487_img.jpg\)](#)

$$ex \quad 4.8MPa = (8MPa \cdot 0.6)$$

19) Ultimate Stress using Factor of Safety 

$$fx \quad U = F.O.S \cdot P$$

[Open Calculator !\[\]\(111c5272ee3f91361f0d2e3665dd6ad0_img.jpg\)](#)

$$ex \quad 48MPa = 4 \cdot 12MPa$$



Variables Used




- **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)
- **l_0** Initial 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)
- **$\epsilon_{\text{component}}$** Strain in Component
- **$\epsilon_{\text{compressive}}$** Compressive Strain
- **ϵ_d** Lateral Strain
- **$\epsilon_{\text{longitudinal}}$** Longitudinal Strain
- **$\epsilon_{\text{longitudinal}}$** Longitudinal Strain
- **$\epsilon_{\text{tensile}}$** 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

- **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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