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Thermal Stress Formulas

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List of 11 Thermal Stress Formulas

Thermal Stress

1) Actual Expansion when Support Yields

Open Calculator

fx $$AE = \alpha_L \cdot L_{bar} \cdot \Delta T - \delta$$

ex $$6mm = 0.0005K^{-1} \cdot 2000mm \cdot 10K - 4mm$$

2) Actual Strain given Support Yields for Value of Actual Expansion

Open Calculator

fx $$\varepsilon_A = \frac{AE}{L_{bar}}$$

ex $$0.003 = \frac{6mm}{2000mm}$$

3) Actual Strain when Support Yields

Open Calculator

fx $$\varepsilon_A = \frac{\alpha_L \cdot \Delta T \cdot L_{bar} - \delta}{L_{bar}}$$

ex $$0.003 = \frac{0.0005K^{-1} \cdot 10K \cdot 2000mm - 4mm}{2000mm}$$

4) Actual Stress given Support Yields for Value of Actual Strain

Open Calculator

fx $$\sigma_{a'} = \varepsilon_A \cdot E_{bar}$$

ex $$0.693MPa = 0.0033 \cdot 210MPa$$

5) Actual Stress when Support Yields

Open Calculator

$$\sigma_{a'} = \frac{(\alpha_L \cdot \Delta T \cdot L_{bar} - \delta) \cdot E_{bar}}{L_{bar}}$$

$$0.63\text{MPa} = \frac{(0.0005\text{K}^{-1} \cdot 10\text{K} \cdot 2000\text{mm} - 4\text{mm}) \cdot 210\text{MPa}}{2000\text{mm}}$$

6) Extension of Rod if Rod is Free to Extend

Open Calculator

$$\Delta L_{Bar} = l_0 \cdot \alpha_T \cdot \Delta T_{rise}$$

$$7.225\text{mm} = 5000\text{mm} \cdot 17\text{E}\hat{}\text{-}6\,^\circ\text{C}^{-1} \cdot 85\text{K}$$

7) Thermal Strain

Open Calculator

$$\varepsilon = \frac{\Delta L}{l_0}$$

$$0.2 = \frac{1000\text{mm}}{5000\text{mm}}$$

8) Thermal Strain given Coefficient of Linear Expansion

Open Calculator

$$\varepsilon_c = \alpha_L \cdot \Delta T_{rise}$$

$$0.0425 = 0.0005\text{K}^{-1} \cdot 85\text{K}$$

9) Thermal Strain given Thermal Stress

Open Calculator

fx $$\varepsilon_s = \frac{\sigma_{th}}{E}$$

ex $$0.434783 = \frac{0.01\text{MPa}}{0.023\text{MPa}}$$

10) Thermal Stress given Coefficient of Linear Expansion

Open Calculator

fx $$\sigma_c = \alpha_L \cdot \Delta T_{rise} \cdot E$$

ex $$0.000978\text{MPa} = 0.0005\text{K}^{-1} \cdot 85\text{K} \cdot 0.023\text{MPa}$$

11) Thermal Stress given Thermal Strain

Open Calculator

fx $$\sigma_s = \varepsilon \cdot E$$

ex $$0.0046\text{MPa} = 0.2 \cdot 0.023\text{MPa}$$

Variables Used

- **AE** Actual Expansion *(Millimeter)*
- **E** Young's Modulus Bar *(Megapascal)*
- E_{bar} Modulus of Elasticity of Bar *(Megapascal)*
- l_0 Initial Length *(Millimeter)*
- L_{bar} Length of Bar *(Millimeter)*
- α_L Coefficient of Linear Expansion *(Per Kelvin)*
- α_T Coefficient of Thermal Expansion *(Per Degree Celsius)*
- δ Yield Amount (Length) *(Millimeter)*
- ΔL Prevented Extension *(Millimeter)*
- ΔL_{Bar} Increase in Bar Length *(Millimeter)*
- ΔT Change in Temperature *(Kelvin)*
- ΔT_{rise} Temperature Rise *(Kelvin)*
- ε Thermal Strain
- ε_A Actual Strain
- ε_c Thermal Strain given Coef. of Linear Expansion
- ε_s Thermal Strain given Thermal Stress
- $\sigma_{a'}$ Actual Stress with Support Yield *(Megapascal)*
- σ_c Thermal Stress given Coef. of Linear Expansion *(Megapascal)*
- σ_s Thermal Stress given Thermal Strain *(Megapascal)*
- σ_{th} Thermal Stress *(Megapascal)*

Constants, Functions, Measurements used

- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Pressure** in Megapascal (MPa)
  Pressure Unit Conversion
- Measurement: **Temperature Difference** in Kelvin (K)
  Temperature Difference Unit Conversion
- Measurement: **Temperature Coefficient of Resistance** in Per Degree Celsius ($°C^{-1}$)
  Temperature Coefficient of Resistance Unit Conversion
- Measurement: **Coefficient of Linear Expansion** in Per Kelvin (K^{-1})
  Coefficient of Linear Expansion Unit Conversion

Check other formula lists

- Mohr's Circle of Stresses Formulas
- Beam Moments Formulas
- Bending Stress Formulas
- Combined Axial and Bending Loads Formulas
- Elastic Constants Formulas
- Elastic Stability of Columns Formulas
- Principal Stress Formulas
- Shear Stress Formulas
- Slope and Deflection Formulas
- Strain Energy Formulas
- Stress and Strain Formulas
- Thermal Stress Formulas
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