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Loss due to Elastic Shortening Formulas

Calculators! Examples! Conversions!

List of 22 Loss due to Elastic Shortening Formulas

Loss due to Elastic Shortening

Post-Tensioned Members

1) Area of Concrete Section given Prestress Drop

Open Calculator

fx $$A_c = m_{Elastic} \cdot \frac{P_B}{\Delta f_p}$$

ex $$12\text{m}^2 = 0.6 \cdot \frac{200\text{kN}}{10\text{MPa}}$$

2) Average Stress for Parabolic Tendons

Open Calculator

fx $$f_{c,avg} = f_{c1} + \frac{2}{3} \cdot (f_{c2} - f_{c1})$$

ex $$10.202\text{MPa} = 10.006\text{MPa} + \frac{2}{3} \cdot (10.3\text{MPa} - 10.006\text{MPa})$$

3) Change in Eccentricity of Tendon A due to Parabolic Shape

Open Calculator

fx $$\Delta e_A = e_{A2} - e_{A1}$$

ex $$9.981\text{mm} = 20.001\text{mm} - 10.02\text{mm}$$

4) Change in Eccentricity of Tendon B due to Parabolic Shape

Open Calculator

fx $$\Delta e_B = e_{B2} - e_{B1}$$

ex $$10.07\text{mm} = 20.1\text{mm} - 10.03\text{mm}$$

5) Component of Strain at Level of First Tendon due to Bending

Open Calculator

fx $$\varepsilon_{c2} = \frac{\Delta L}{L}$$

ex $$0.029412 = \frac{0.3\text{m}}{10.2\text{m}}$$

6) Prestress Drop

Open Calculator

fx $$\Delta f_p = E_s \cdot \Delta \varepsilon_p$$

ex $$10\text{MPa} = 200000\text{MPa} \cdot 0.00005$$

7) Prestress Drop given Modular Ratio

Open Calculator

fx $$\Delta f_p = m_{Elastic} \cdot f_{concrete}$$

ex $$9.96\text{MPa} = 0.6 \cdot 16.6\text{MPa}$$

8) Prestress Drop given Strain due to Bending and Compression in Two Parabolic Tendons

Open Calculator

fx $$\Delta f_p = E_s \cdot (\varepsilon_{c1} + \varepsilon_{c2})$$

ex $$106000\text{MPa} = 200000\text{MPa} \cdot (0.5 + 0.03)$$

9) Prestress Drop given Stress in concrete at Same Level due to Prestressing Force

Open Calculator

fx $$\Delta f_p = E_s \cdot \frac{f_{concrete}}{E_{concrete}}$$

ex $$33200\text{MPa} = 200000\text{MPa} \cdot \frac{16.6\text{MPa}}{100\text{MPa}}$$

10) Prestress Drop when Two parabolic Tendons are Incorporated

Open Calculator

fx $$\Delta f_p = E_s \cdot \varepsilon_c$$

ex $$9000\text{MPa} = 200000\text{MPa} \cdot 0.045$$

11) Stress in Concrete given Prestress Drop

Open Calculator

fx $$f_{concrete} = \frac{\Delta f_p}{m_{Elastic}}$$

ex $$16.66667\text{MPa} = \frac{10\text{MPa}}{0.6}$$

12) Variation of Eccentricity of Tendon B

Open Calculator

fx $$E_{B(x)} = e_{B1} + \left(4 \cdot \Delta e_B \cdot \frac{x}{L}\right) \cdot \left(1 - \left(\frac{x}{L}\right)\right)$$

ex $$10.10914\text{mm} = 10.03\text{mm} + \left(4 \cdot 20.0\text{mm} \cdot \frac{10.1\text{mm}}{10.2\text{m}}\right) \cdot \left(1 - \left(\frac{10.1\text{mm}}{10.2\text{m}}\right)\right)$$

13) Variation of Eccentricity on Tendon A

Open Calculator

fx $$E_{A(x)} = e_{A1} + \left(4 \cdot \Delta e_A \cdot \frac{x}{L}\right) \cdot \left(1 - \left(\frac{x}{L}\right)\right)$$

ex $$10.05957\text{mm} = 10.02\text{mm} + \left(4 \cdot 10.0\text{mm} \cdot \frac{10.1\text{mm}}{10.2\text{m}}\right) \cdot \left(1 - \left(\frac{10.1\text{mm}}{10.2\text{m}}\right)\right)$$

Pre-Tensioned Members

14) Initial Prestress given Prestress after Immediate Loss

Open Calculator

fx $$P_i = P_o \cdot \frac{A_{\text{Pretension}}}{A_{\text{Pre tension}}}$$

ex $$200\text{kN} = 96000\text{kN} \cdot \frac{0.025\text{mm}^2}{12\text{mm}^2}$$

15) Initial Strain in Steel for Known Strain due to Elastic Shortening

Open Calculator

fx $$\varepsilon_{pi} = \varepsilon_c + \varepsilon_{po}$$

ex $$0.05 = 0.045 + 0.005$$

16) Modular Ratio given Prestress after Immediate Loss

Open Calculator

fx $$m_{\text{Elastic}} = \Delta f_{\text{Drop}} \cdot \frac{A_{\text{Pre tension}}}{P_o}$$

ex $$2.5 = 0.02\text{MPa} \cdot \frac{12\text{mm}^2}{96000\text{kN}}$$

17) Prestress Drop given Initial Prestress Force

Open Calculator

fx $$\Delta f_{Drop} = P_i \cdot \frac{m_{Elastic}}{A_{Pretension}}$$

ex $$0.01044\text{MPa} = 435\text{kN} \cdot \frac{0.6}{0.025\text{mm}^2}$$

18) Prestress Drop given Pressure after Immediate Loss

Open Calculator

fx $$\Delta f_{Drop} = \left(\frac{P_o}{A_{Pre\ tension}}\right) \cdot m_{Elastic}$$

ex $$0.0048\text{MPa} = \left(\frac{96000\text{kN}}{12\text{mm}^2}\right) \cdot 0.6$$

19) Prestressing Force after Immediate Loss given Initial Prestress

Open Calculator

fx $$P_o = P_i \cdot \frac{A_{Pre\ tension}}{A_{Pretension}}$$

ex $$208800\text{kN} = 435\text{kN} \cdot \frac{12\text{mm}^2}{0.025\text{mm}^2}$$

20) Residual Strain in Steel for Known Strain due to Elastic Shortening

Open Calculator

fx $$\varepsilon_{po} = \varepsilon_{pi} - \varepsilon_c$$

ex $$0.005 = 0.05 - 0.045$$

21) Strain in Concrete due to Elastic Shortening

Open Calculator

fx $\varepsilon_c = \varepsilon_{pi} - \varepsilon_{po}$

ex $0.045 = 0.05 - 0.005$

22) Transformed Area of Prestress Member for Known Pressure Drop

Open Calculator

fx $A_{Pretension} = m_{Elastic} \cdot \frac{P_i}{\Delta f_{Drop}}$

ex $0.01305\text{mm}^2 = 0.6 \cdot \frac{435\text{kN}}{0.02\text{MPa}}$

Variables Used

- A_c Concrete Occupied Area *(Square Meter)*
- $A_{Pre\ tension}$ Pre-Tensioned Area of Concrete *(Square Millimeter)*
- $A_{Pretension}$ Transformed Section Area of Prestress *(Square Millimeter)*
- $E_{A(x)}$ Eccentricity Variation of Tendon A *(Millimeter)*
- e_{A1} Eccentricity at End for A *(Millimeter)*
- e_{A2} Eccentricity at Midspan for A *(Millimeter)*
- $E_{B(x)}$ Eccentricity Variation of Tendon B *(Millimeter)*
- e_{B1} Eccentricity at End for B *(Millimeter)*
- e_{B2} Eccentricity at Midspan B *(Millimeter)*
- $E_{concrete}$ Modulus of Elasticity Concrete *(Megapascal)*
- E_s Modulus of Elasticity of Steel Reinforcement *(Megapascal)*
- $f_{c,avg}$ Average Stress *(Megapascal)*
- f_{c1} Stress at End *(Megapascal)*
- f_{c2} Stress at Midspan *(Megapascal)*
- $f_{concrete}$ Stress in Concrete Section *(Megapascal)*
- L Length of Beam in Prestress *(Meter)*
- $m_{Elastic}$ Modular Ratio for Elastic Shortening
- P_B Prestress Force *(Kilonewton)*
- P_i Initial Prestress Force *(Kilonewton)*
- P_o Prestressing Force after Loss *(Kilonewton)*
- x Distance from Left End *(Millimeter)*
- Δe_A Change in Eccentricity at A *(Millimeter)*

- Δe_B Change in Eccentricity B *(Millimeter)*
- Δf_{Drop} Drop in Prestress *(Megapascal)*
- Δf_p Prestress Drop *(Megapascal)*
- ΔL Change in Length Dimension *(Meter)*
- $\Delta \varepsilon_p$ Change in Strain
- ε_c Concrete Strain
- ε_{c1} Strain due to Compression
- ε_{c2} Strain due to Bending
- ε_{pi} Initial Strain
- ε_{po} Residual Strain

Constants, Functions, Measurements used

- Measurement: **Length** in Millimeter (mm), Meter (m)
  Length Unit Conversion
- Measurement: **Area** in Square Meter (m²), Square Millimeter (mm²)
  Area Unit Conversion
- Measurement: **Pressure** in Megapascal (MPa)
  Pressure Unit Conversion
- Measurement: **Force** in Kilonewton (kN)
  Force Unit Conversion

Check other formula lists

- **Loss due to Anchorage Slip, Friction Loss and General Geometric Properties Formulas**
- **Loss due to Elastic Shortening Formulas**

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